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CONTENTS

ILLUSTRATIONS

MOTHZV-2: A COMPUTER SIMULATION OF *HELIOTHIS ZEA* AND *HELIOTHIS VIRESCENS* POPULATION DYNAMICS

Users Manual

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ABSTRACT

Consisting of a main program and 16 subroutines, MOTHZV–2 simulates the population dynamics of *Heliothis zea* (Boddie) and *Heliothis virescens* (F.) from egg to adult. The input includes measurable and reported factors influencing population development, such as crop phenology, temperature, moonlight, migration, predation, parasitism, oviposition, and cannibalism. The model accurately predicted field population of *Heliothis* eggs, larvae, and adults. The complete computer program and example input and output data are given.
KEY WORDS: computer-simulated *Heliothis* populations, *Heliothis virescens, Heliothis zea,* insect population dynamics, insect population forecasting, MOTHZV–2.

INTRODUCTION

MOTHZV–2 is a computer simulation of the population dynamics of *Heliothis zea* (Boddie) and *Heliothis virescens* (F.). It is based on MOTHZ–1 (*5*) and MOTHZ–2[2] but incorporates considerably more detailed population and physiological algorithms. Stinner et al. (*22*) described a somewhat similar *Heliothis* model; however, they did not include the details of various biological phenomena affecting population dynamics. Most of the basic factors, e.g., mortality, parasitism, and crop phenology, were entered in the context of the input data. Their model did, however, include a spatial grid of crop types so that movement of the population could be studied.

MOTHZV–2 consists of a main program and 16 subroutines. Simulation begins with input of either eggs or moths and can be carried through as many generations as occur during one season. No provisions are included for simulating moths entering or emerging from diapause. A bookkeeping system is used so that the numbers of eggs, first- to third-instar larvae, fourth- and fifth-instar larvae, pupae, preovipositing adults, and ovipositing adults can be recorded for each day of simulation. Printouts of all input as well as other calculated parameters are made along with daily population of simulated insects. Graphs of life tables are optional.

We describe the model in the order of the insects' life cycle events. The model can be used to simulate either *H. zea* or *H. virescens* or both

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[2] Hartstack, A. W., Jr. Model of *Heliothis zea*. 1973 Annual Report of the Cotton Insects Research Laboratory, College Station, Tex. 77840, 158 pp.

simultaneously. If in the following discussion no reference to species is made, both species are treated alike. Many biological factors other than those in the model affect *Heliothis* populations, but at this time these parameters are assumed to be constants or are neglected completely. Also, in some cases, more information is needed on the assumptions made in the model to enhance accurate prediction.

The program is written in FORTRAN and has been run on IBM 370 and AMDAHL 470 computers. It is stored on disk in compiled form at Texas A&M University Computer Center.

DESCRIPTION OF MODEL

Rate of Egg Production

Temperature has been shown to influence the number of eggs a moth lays, but research results have not been consistent (*2, 8, 17*). In general, maximum egg production is attained between 22.2° and 25.5° C and is reduced to nearly zero at 12.8° and 35° C. Figure 1 (G9) shows the relation between oviposition rate and temperature as described by

$$X = |75 - \text{EGLYTM}| \quad (1)$$

and

$$P_1 = 1.1 - 0.05146X, \quad (2)$$

where EGLYTM = average temperature (°F) during the 3-hour period after sunset (fig. 1:G7),

and P_1 = probability of oviposition (assumed to be 1.0 between 22.2° and 25.5° C).

Quaintance and Brues (*21*) and Phillips and Whitcomb (*18*) found that most eggs were laid in early evening. However, no data are available to predict what happens if temperature inhibits oviposition early in the evening but becomes ideal later or during the day. McColloch (*13*) stated that oviposition normally occurs at night but that it may occur during the daytime on cloudy or cool days. Accordingly, the 3 hours after sunset were assumed to be the oviposition period.

Moth age has been shown to affect fecundity (*2, 8, 17, 21*). Isely (*8*) and Quaintance and Brues (*21*) also found an interaction between age and temperature in which longevity and reproductive potential were greater at cooler temperatures (21.6°–26.7° C). Higher temperatures increased daily production of eggs but shortened the oviposition period, thereby reducing the overall reproductive potential. Figure 2 shows the oviposition period of *Heliothis* moths calculated for two temperatures. A function such as the gamma might fit these data; however, we used a linear approximation by fitting straight-line segments through the points determined by[3]

$$\text{TRUN}_i = \left(\sum_{j=i-\text{AGE}}^{i} \text{TEMAVG}_j \right) / \text{AGE}, \quad (3)$$

$$\text{PREOVI} = (5{,}330)\,(\text{TEMAVG}_i^{-1.82}) + 0.6, \quad (4)$$

$$\text{IPEAK} = (3{,}030{,}000)\,(\text{TRUN}_i^{-3.11}), \quad (5)$$

$$\text{ITOP} = (240{,}000)\,(\text{TRUN}_i^{-2.61}), \quad (6)$$

and

$$\text{IEND} = (911{,}000)\,(\text{TRUN}_i^{-2.63}), \quad (7)$$

where TRUN_i = average temperature during moth's adult life on day i = AGE,

TEMAVG_i = average temperature for ith day of moth's life (°F),

AGE = age of moth on day of simulation,

PREOVI = length of preoviposition period (rounded to nearest whole day),

IPEAK = age (rounded to nearest whole day) when *Heliothis* moth attains maximum reproductive potential,

ITOP = number of days (rounded to the nearest whole day) a moth remains at maximum reproductive potential,

and IEND = age at which a moth no longer oviposits.

When the above events are calculated, a linear relationship between them is assumed, so egg production potential (P_2) can be readily calculated.

[3] Some of the terms used in the equations in the model description section of this paper may be slightly different in spelling or meaning from the terms used in the computer program. This was done to simplify explanation of what the simulation model accomplishes rather than how it is accomplished.

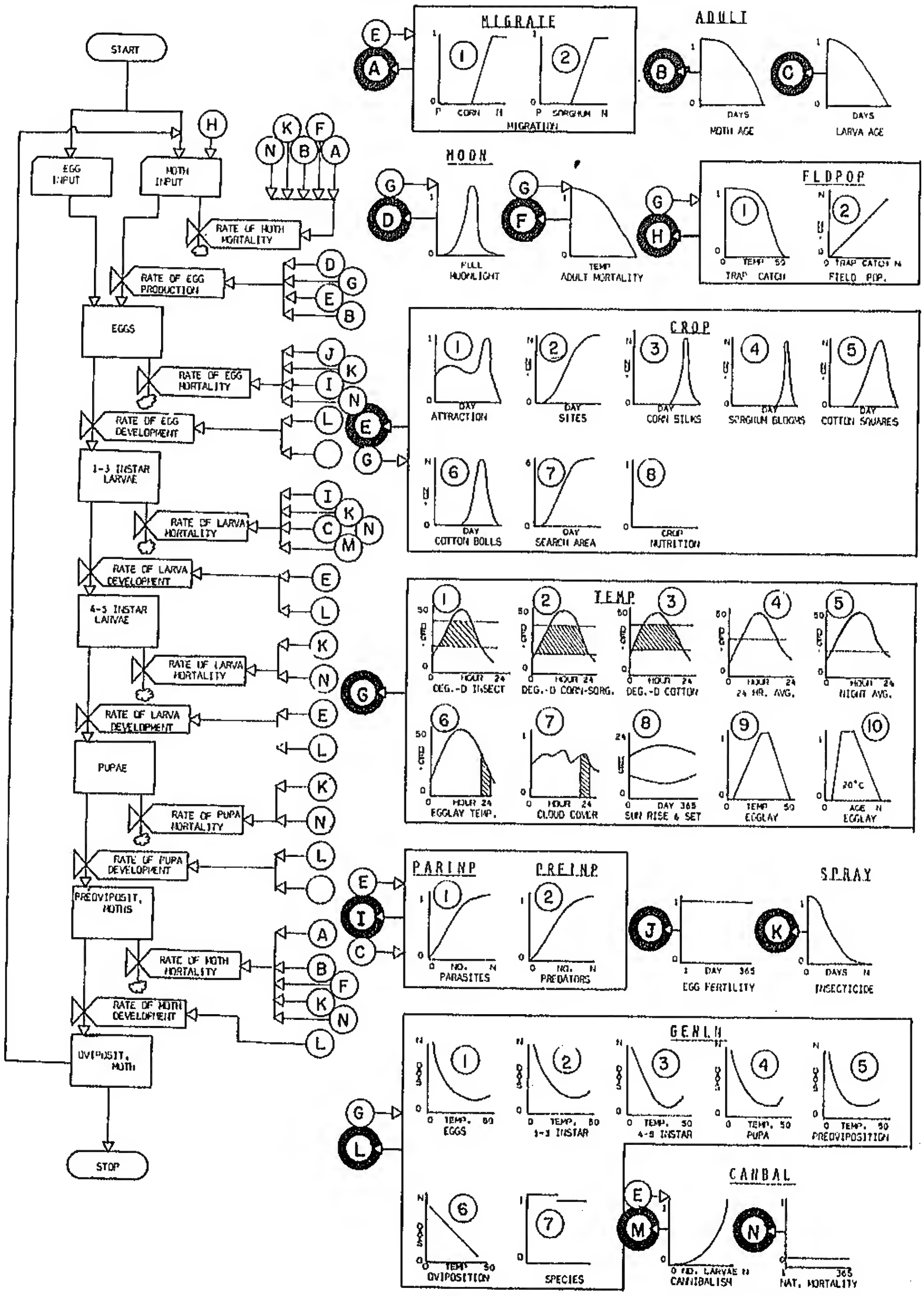


FIGURE 1.—Flow diagram of MOTHZV-2.

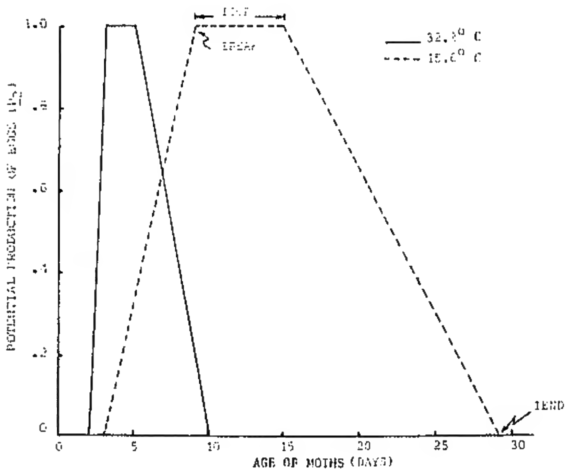


FIGURE 2.—The interaction of age and average daily temperature on reproduction potential of *Heliothis* moths.

Researchers have shown that phenological phenomena (e.g., silking date) have a significant influence on the probability of *Heliothis* moths' being attracted to a crop and ovipositing (*3, 6, 8, 13, 19*). This influence makes a crop submodel necessary. A corn model developed by Curry (*1*) was adapted to generate the needed corn phenology (fig. 1: E—1–3, 7, 8). (The probable attraction of corn, P_3, to *H. virescens* is assumed to be zero, since corn is not a reported host of this insect.) A simple sorghum model and a portion of SIMCOT II (*14*), a cotton model, were also adapted (fig. 1: E—1, 2, 4–8).

Nemec (*15, 16*) reported reduced oviposition by *Heliothis* moths during periods of full moon and during simulated moonlight. Oviposition was inhibited 3 or 4 days before full moon but was resumed 1 or 2 days after full moon and usually peaked 3 or 4 days after full moon. Hartstack's data (*6*) showed a significant reduction in rates of *Heliothis* population increase during moonlight periods. Consequently, if one assumes that maximum egg laying is from 2030 to 2330 hours (approximately, the 3-hour period after sunset), the relative amount of moonlight during that period can be calculated (fig. 3). Since the moon rises about 1 hour later each night, the 2030–2330 period has considerably more moonlight before full moon than after. The probability of maximum oviposition (P_4) in relation to moonlight is stored as a data array and used in the simulation as needed. The probability is increased (not >1.0) for cloud cover (e.g., if cloud cover is 50%, the effect of moonlight is reduced by 50%).

The egg-laying probability (EGLYPR) for a particular day is calculated by multiplying the four probability factors together:

$$\text{EGLYPR} = (P_1)(P_2)(P_3)(P_4). \qquad (8)$$

The total number of eggs laid per moth per day (TOLEGG) is calculated by

$$\text{TOLEGG} = (\text{EGLYPR})(\text{EGPEMT}), \qquad (9)$$

where EGPEMT = maximum number of eggs a *Heliothis* moth could lay per day if all factors were ideal.

EGPEMT is assumed to be 300 and 400, respectively, for *H. zea* and *H. virescens* and would result in maximum lifetime laying of 2,000 to 3,000 eggs per moth (*8, 21*).

Egg Mortality

There are many probable causes of egg infertility (e.g., temperature, population density, number of matings, and age). MOTHZV–2 uses a constant fertility rate of 90% (fig. 1: J). The model does not remove infertile eggs from the egg population until they should have hatched.

Parasites, specifically *Trichogramma* spp., are an important cause of egg mortality (*11, 13*). Detailed quantitative models for the population dynamics of various egg parasites have

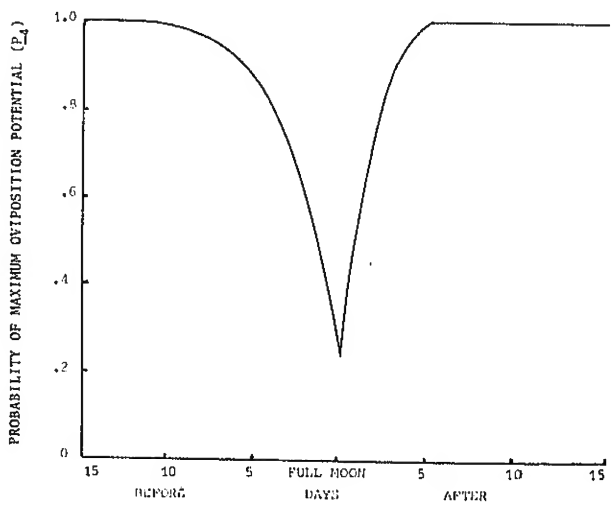


FIGURE 3.—The probability of maximum oviposition as related to the relative intensity and phase of moonlight during the 3-hour period after sunset.

not been constructed at this time; therefore, estimates must be used (fig. 1: I—2). Four options are available:

Option 1.—Enter number of parasites. Knipling and McGuire (*10*) presented an empirical population model of parasites based on the following assumptions: (a) 5,000 *Trichogramma* per acre would find 50% of the host eggs. (b) 10,000 *Trichogramma* per acre would search the same plant area twice. However, since searching is random, the additional 5,000 parasites would search one-half the area previously searched and one-half the unsearched area, thus leaving one-fourth the area unsearched. (c) The searching capability of *Trichogramma* and its efficiency in parasitizing host eggs are assumed to be completely independent of host egg density. These assumptions were based on a search area factor (SAREA) of 1.0, which is assumed to occur when the crop becomes attractive (6- to 12-inch height for corn) and to increase to about 6.0 at crop maturity. Equation 10 is Knipling and McGuire's model.

$$\text{PTRICH} = 1 - \exp\left(\frac{(-0.693)\ (\text{TRICH})}{(\text{N})\ (\text{SAREA})}\right), \quad (10)$$

where PTRICH = probability of parasitism by *Trichogramma*,
TRICH = number of parasites,
N = number of parasites required to obtain 50% parasitism,
and SAREA = relative search area.

N is assumed to be 5,000 (as postulated by Knipling and McGuire) for native egg parasites. N was calculated to be 45,000 for reared *Trichogramma* (specifically, for those reared at Agricultural Research Service's Cotton Insects Research Laboratory, College Station, Tex.). The number of parasites must be read in for each day of simulation. Figure 4 shows typical parasitism curves calculated by the model.

Option 2.—Enter daily percentage of parasitism. If the number of parasites is not available, an estimated daily percentage of parasitism can be read in.

Option 3.—Enter maximum daily rate of parasitism. The maximum daily rate of parasitism is assumed to occur in corn during the peak silking period (90%–95% silks present), when many eggs are present. From the egg parasitism percentage the model generates an egg parasitism curve starting from the day when the crop becomes attractive; figure 5 shows the curve for corn. Parasitized eggs are not removed from the egg population by the model until after the parasites would have emerged, since field counts of eggs may include parasitized eggs. A running total of parasitized eggs is kept so that the apparent field parasitism can be calculated for each day for comparison with field data for verification.

Option 4.—Enter number of *Trichogramma*. The rate of parasitism by *Trichogramma* is calculated as a function of the number and the age of adult *Trichogramma* and of environ-

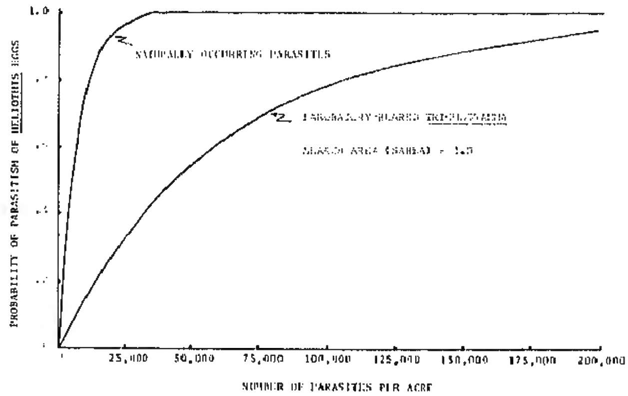


FIGURE 4.—Typical egg parasitism curves generated by model.

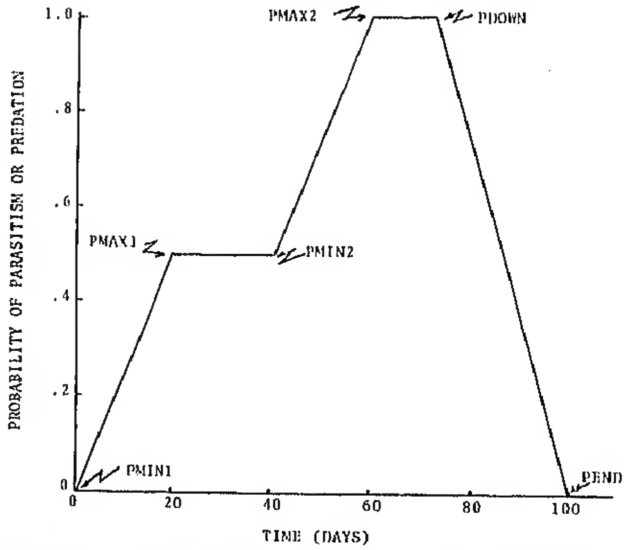


FIGURE 5.—Parasitism or predation curve generated for corn (option 3).

mental temperature. The potential population of *Trichogramma* emerging from parasitized *Heliothis* eggs is calculated and can be used to predict parasitism rates once the population of *Trichogramma* has been initialized.

Egg predators are handled like parasites. Knipling and McGuire's (*10*) model, equation 10, was adapted for egg predators. The value of N is assumed to be 14,500 and 45,000 for native egg predators and laboratory-reared *Chrysopa*, respectively (determined from field data by the Cotton Insects Research Laboratory). Field counts of predators are obtainable and can be used in the model. Egg predators have been placed by the Cotton Insects Research Laboratory into seven groups. The number of predators in each group can be adjusted by a relative efficiency factor, which can be estimated from intuitive and factual knowledge of the predators. The predator groups are *Scymnus*, other Coccinellidae, other Coleoptera, *Orius*, *Geocoris*, other Hemiptera, and *Chrysopa* immatures.

The daily percentage of predation can be used if the number of predators is not available. Also, as described for parasites, the maximum daily rate of predation can be used, and the model will generate daily rates.

The model provides for a daily input of mortality from ovicides for each species. A constant 4.5% daily rate is assumed for mortalities caused by other agents.

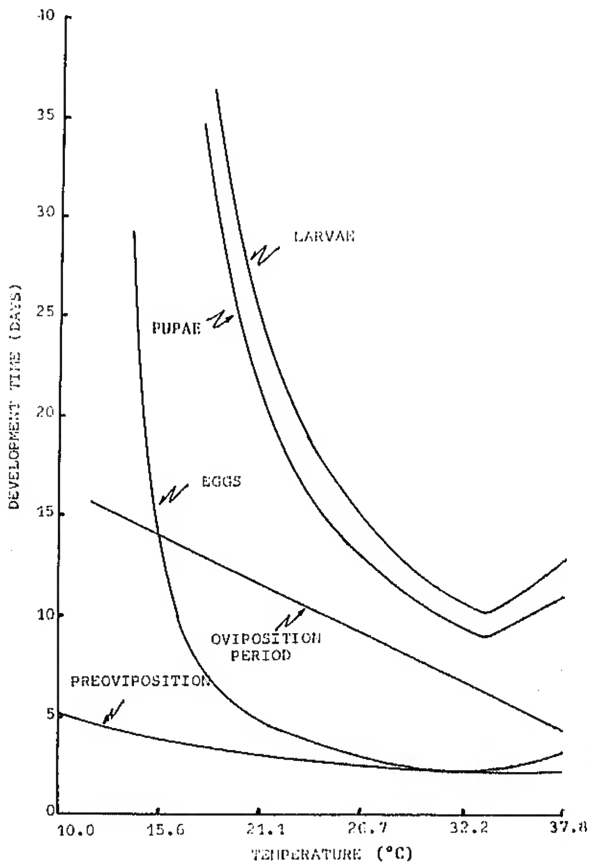


FIGURE 6.—Development time as a function of temperature for *Heliothis* eggs, larvae, pupae, and adults.

Rate of Egg Development

Researchers have shown that temperature is the major factor regulating the rate of development of *Heliothis* under normal conditions (*2, 6, 8, 12, 21*). Development ceases at temperatures below 12.6° C and is interrupted at temperatures above 33.3° C (fig. 1: G—1).

The 484.9 degree-days required for a complete life cycle of *Heliothis* (*6*) was divided into stages (e.g., eggs and small larvae). It was determined that 40.5 degree-days between 12.6° and 33.3° C were required for development and hatching of eggs. Degree-days above 33.3° C are subtracted from the sum. Figure 6 shows the development time in days required for various temperatures. Hartstack (*6*) and Fye and McAda (*2*) reported a slightly longer time for *H. virescens* than for *H. zea;* therefore, the model is written so that a percentage of reduction or increase can be used.

Larval Mortality

Knipling (*9*) developed a population model for larval parasites that is, in principle, identical to the *Trichogramma* model discussed earlier. The value of N for larval parasites was assumed to be 300, as suggested by Knipling. Parasitism is applied only to small larvae (first- to third-instar). If numbers of parasites are not available, the daily percentage of parasitism or the maximum daily rate can be used for small larvae. The larval parasitism pattern is calculated exactly as described for egg parasitism (shown in fig. 5).

Knipling and McGuire's (*10*) model, equation 10, was also adapted for predators of small larvae. The value of N was assumed to be 9,000 and 13,000 for native and laboratory-reared *Chrysopa* immatures, respectively (determined from field data by the Cotton Insects Research Laboratory). The daily rate of predation calcu-

lated by equation 10 is reduced in relation to the age of the larvae, as follows:

$$\text{PREDOR}' = (\text{PREDOR}) \exp\left(\frac{(-0.42)\,(\text{AGE})}{0.657}\right), \quad (11)$$

where PREDOR′=percentage of predation after adjustment for age of larvae,

PREDOR=percentage of predation calculated by equation 10,

and AGE=age of larvae in days.

Larval predators are grouped by the Cotton Insects Research Laboratory into the same groups listed for egg predators. The larval predator numbers are adjusted by estimated relative efficiency factors. Daily percentage of predation of small larvae can be read in if the number of predators is not available. The daily percentage is reduced for age of larvae by equation 11. If the maximum daily rate of predation of small larvae is used, the larval predation pattern is calculated as was described for egg predation (shown in fig. 5), and again the daily percentage is reduced for age of larvae by equation 11.

Mortality of larvae by cannibalism is considered for *H. zea* only (fig. 1: M). Subroutine CROP calculates the number of "sites" available daily for egg laying. Pieters and Sterling (*20*) reported that *H. zea* eggs are distributed in the field as described by the negative bionomial and that the dispersion factor (DF) of the negative bionomial for *H. zea* eggs in cotton is 0.36. Cannibalism of *H. zea* is considered by many to be negligible in cotton but very high in corn, since *H. zea* eggs are concentrated on silks when these sites are available. A dispersion factor of 0.36 is assumed here for corn. The number of sites available is assumed to be the number of plants times the relative search area (SAREA) until silks appear. At that time the number of sites is reduced to the number of silks available, since most eggs are laid on silks when they are available. It is assumed that when silks become 15 days old they are dry and no longer attractive for oviposition. It is also assumed that a larvae reaches the fourth instar before it becomes cannibalistic and destroys all smaller larvae on the same site. Only a small percentage of small larvae will be destroyed in 1 day, but this percentage will increase as the larvae develop and are more active. The number of surviving larvae is determined by

$$\text{PRBLAR}_i = \text{TOTALS3}_i \div \text{SITES}_j, \quad (12)$$

$$\text{ATE}_i = 0.05 + 0.05(\text{AGE}_i), \quad (13)$$

and

$$\text{POP}'_i = \text{POP}_i - (\text{POP}_i)(\text{PRBLAR}_i)(\text{ATE}_i), \quad (14)$$

where PRBLAR_i=probability of a large *H. zea* larva being on a site on day *i*,

TOTAL3_i=number of surviving large *H. zea* larvae on day *i*,

SITES_j=number of sites available for oviposition on day *j* (day *j* is the day when the eggs that are being advanced through the simulation were laid),

ATE_i=percentage of small *H. zea* larvae cannibalized on sites with a large larvae on day *i*.

POP_i=the number of small *H. zea* larvae surviving on day *i* from eggs laid on day *j*,

and POP'_i=the small *H. zea* larvae surviving cannibalism until the next day.

This calculation is done each day until the surviving small larvae laid on day *j* become large larvae. On the last day of the third instar the probability of more than one surviving small larva being on the same site is calculated, and the population is reduced to one per site by solving

$$\text{XBAR}_i = \text{POP}_i \div \text{SITES}_j, \quad (15)$$

$$\text{PRBNEW}_j = 1 - \left(\frac{\text{DF}}{\text{DF} + \text{XBAR}_i}\right)^{\text{DF}}, \quad (16)$$

and

$$\text{POP}'_i = (\text{SITES}_j)(\text{PRBNEW}_j), \quad (17)$$

where XBAR_i=number of surviving small *H. zea* larvae per site on day *i*,

PRBNEW_j=probability that one or more small larvae are on a site on day *j*,

and DF=dispersion factor of the negative bionomial (0.36).

The model provides for separate inputs of mortalities of small and large larvae from insecticides. A constant daily rate of 4.0% is assumed for mortalities from natural causes.

Rate of Larval Development

Degree-day figures used for the average development of small larvae (one- to three-instar) and large larvae (four- or five-instar) are 81.7 and 120.6, respectively, calculated as for eggs. Isely (*8*) reported different development times for *H. zea* larvae held at constant temperatures when they were fed various crops and crop parts. Corn ears were apparently the most nutritious, since larval development was significantly faster with this diet. Our unpublished field data at College Station support these results, and this factor has been included in the model. The nutrition factor used for corn plants and for cotton plants and fruit is 1.0. If larvae are developing on corn plants when ears are present, 0.65 is used. The nutrition factor for larvae developing on sorghum is 1.1.

Pupal Mortality

The only mortality inputs for pupae are a constant natural mortality of 3.0% per day. Mortalities from insecticides can also be used.

Rate of Pupal Development

Pupae require 123.9 degree-days for development. Figure 6 shows this temperature-time relationship.

Adult Mortality

Fye and McAda (*2*) and Sterling[4] reported a temperature survival relationship for *Heliothis* moths. Figure 7 shows the probability of survival of adult moths as related to age and temperature. The following equations were developed to describe this survival probability:

$$\mathrm{FACTK} = 1.2919 + (0.02724)\,(\mathrm{TEMAVG}), \quad (18)$$

and

$$\mathrm{SURV} = 1.0 - 1.7724 \exp\left(\frac{-11.4457}{(\mathrm{FACTK})\,(\mathrm{L})}\right), \quad (19)$$

where FACTK=temperature constant for exponential equation,

TEMAVG=average air temperature (°F) on day of simulation,

SURV=probability of survival to L age,

and L=age of moth in days.

Survival of moths at temperatures below 20° C is assumed to be the same as at 20° C. Daily mortalities from insecticides can be used for adult moths of both species. Snow et al. (*24*) reported that few moths lived beyond the sixth night after their emergence in the field. To simulate this high mortality, we used a daily rate of 15.0% for mortalities from natural causes.

Migration

Crop phenological data are used to calculate emigration from corn and sorghum. In corn and sorghum the mature date (IM) is used to start the emigration, which builds to a maximum at the dry date (ID) and then remains constant for the rest of the simulation. The maximum percentage of emigration is read in. These moths are stored and can be used later as immigrants to other crops.

Duration of Oviposition

Fye and McAda (*2*) and Isely (*8*) showed

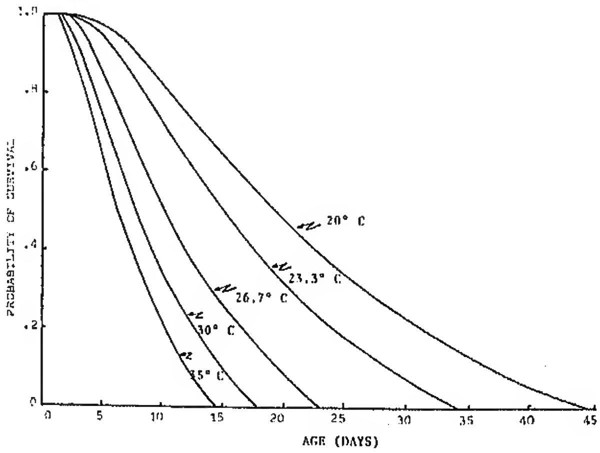


FIGURE 7.—Probability of *Heliothis* moth survival as related to age and temperature.

[4] Winfield L. Sterling, personal communication.

that the duration of oviposition is a function of temperature. We used the following equation to estimate the duration and to terminate it:

$$IGENZV6=28.25 -(0.24037)(TEMAVG), \quad (20)$$

where IGENZV6=length of oviposition period,

and TEMAVG=average air temperature (°F) on day of simulation.

DESCRIPTION OF SUBROUTINES

Temperature (TEMP)

All temperature and cloud-cover input and the calculation of degree-days are handled by TEMP (fig. 1: G). There are two options for putting daily temperature in: (1) hourly temperature and (2) daily maximum and minimum temperatures. The hourly temperature takes precedence if the data are available. When maximum and minimum temperatures are used, hourly temperatures are estimated by assuming a consine-wave fluctuation between maximum and minimum readings at 1400 and 0200 hours, respectively.

TEMP calculates the degree-days for corn as well as for *Heliothis*. For example, the degree-days for *Heliothis* are calculated by

$$ED_a=\sum_{X=1}^{24}(T_x-12.6)-2(T_x-33.3) \quad (21)$$

and $$ED_a'=ED_a+ED_{a-1}+\ldots+ED_{a-n}, \quad (22)$$

where ED_a=degree-days on day a,
X=hour,
T_x=hourly temperature on day a (°C),
ED_a'=accumulated degree-days from day n to day a, imposing only positive values of $(T_x-12.6)$ and $(T_x-33.3)$ be summed,
and n=day number of start of simulation (Julian).

Multiplying $(T_x-33.3)$ by 2 causes a reduction in degree-days for temperatures above 33.3° C, thereby simulating the retardation of the development of *Heliothis* by high temperatures. Also calculated in TEMP are the accumulated degree-days for corn, sorghum, and cotton, the average daily temperature, the average nightly temperature, the average temperature for the 3 hours after sunset (oviposition temperature), the time of sunrise and sunset, and the percentage of cloud cover during the oviposition period.

Generation Length (GENLN)

The degree-days calculated in TEMP are used to calculate the number of days required for development of the *Heliothis* (fig. 1: L). The following equation illustrates the GENLN function:

$$D_e=ED'_{a+n}-ED'_a>40.5, \quad (23)$$

where D_e=degree-days required for development of eggs,
ED'_{a+n}=number of degree-days accumulated to day $a+n$,
ED'_a=number of degree-days accumulated to day a,
and n=number of days required for egg development from day a.

Also calculated in GENLN are the lengths of the preoviposition and oviposition periods (equations 4 and 22). The development times are also adjusted for the percentaegs of difference between species.

Moonlight (MOON)

This subroutine calculates the number of days, before or after, that each day of the simulation is from full moon. MOON then stores in the ADMOON array the proper moonlight adjustment factor, P_4, for egg laying.

Insecticides (SPRAY)

This subroutine reads in daily mortalities caused by insecticides for eggs, small larvae, large larvae, pupae, adults, parasites, and predators for each species.

Parasites (PARINP)

This subroutine calculates parasitism of eggs and larvae as described under "Egg Mortality."

Predators (PRDINP)

This subroutine calculates predation of eggs and larvae as described previously under "Egg Mortality."

Adult Moths (ADULT)

This subroutine calculates adult mortality as described previously.

Crop Phenology (CROP)

This subroutine calculates the various phenological stages, the relative search area, and the number of sites (e.g., ears) for corn. Degree-days as previously described are used to make these predictions.

Cannibalism (CANBAL)

This subroutine calculates the probability of cannibalism of *H. zea* larvae.

Migration (MIGRAT)

This subroutine calculates the probability of moths migrating away from a particular crop.

Field Population (FLDPOP)

This subroutine converts light-trap catches to field populations expressed as moths per acre (*5, 7*). The light-trap catches are adjusted for low night temperatures. Light-trap catches for 5 years (1970–74) were reduced significantly before June 10. The effect of temperature was large early (April) and decreased to nearly zero by June 10. Hardwick (*4*) also found a significant correlation between low night temperatures and light-trap catches. Figure 8 shows the effect of temperature on trap catch on four dates (Julian). We used a quadratic equation to calculate the adjustment for any particular day. The coefficients of the quadratic (A) and the base factor (F=26.7° C) are calculated by four linear equations whose variable is time (Julian date):

$$A1=812.4-5.8(IDY), \qquad (24)$$

$$A2=28.6753+0.20281(IDY), \qquad (25)$$

$$A3=0.252667-0.001762(IDY), \qquad (26)$$

$$F=136.9-0.86667(IDY), \qquad (27)$$

$$F'=A1+A2(NA)+A3(NA)^2, \qquad (28)$$

and $TRAPIN=F \div F'$, (29)

where IDY=Julian date,
F′=temperature factor,
NA=average temperature from 1800 to 0600 hours (°F),
and TRAPIN=adjustment factor for trap catch.

This adjustment is limited to the College Station, Tex., climate or a similar one. The time factor would have to be changed for areas where early-season temperatures differ significantly. These equations are only valid to day 153 of the simulation, and all temperatures below 12.8° C are assumed to be 12.8° C.

Graph (GRAPH)

This subroutine may be used if a graph of the output or input is needed.

Heliothis Population Input (EGGINP)

This subroutine reads in the *Heliothis* populations for initiating the simulation. These populations can be either eggs or moths. White eggs (eggs up to 1 day old) or total eggs can be used as input. The eggs are read in daily. If total eggs is used, EGGINP divides total egg num-

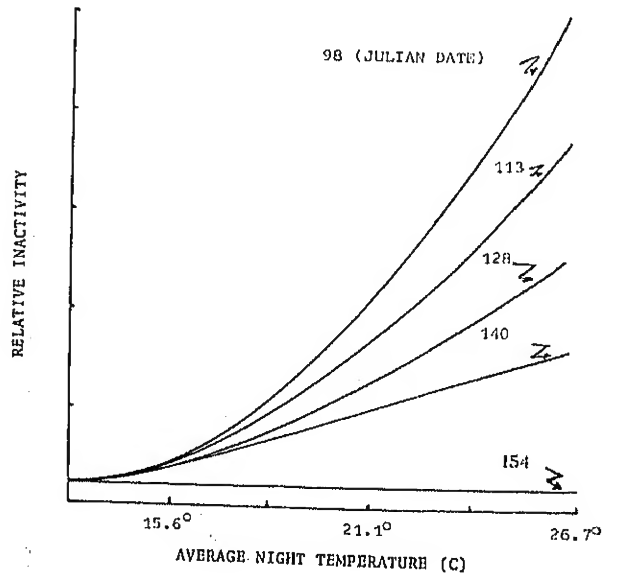


FIGURE 8.—Relative insect inactivity as a function of temperature at different times of the year compared to the inactivity on day 154.

ber by 0.31 to obtain an estimated white-egg count and moves the count to 3 days earlier.

Light-trap catches tabulated by sex or on a total basis can be used as input. Subroutine FLDPOP converts the catch to an estimated number of moths per acre. Male and female moth data are preferred if available because the sex ratio is calculated and used later by CROP to estimate egg-laying probability.

Double Three-Day Moving Average (SMOOTH)

This subroutine applies a double 3-day moving average to insect population data.

Trichogramma (TRKGRM)

This subroutine is a model of the population dynamics of *Trichogramma*. Development of *Trichogramma* in *Heliothis* eggs is controlled by temperature, and potential parasitism is controlled by number and age of adult *Trichogramma*. These relationships are described by

$$PTEMP_1 = |72 - TEMAVG_i| \qquad (30)$$

and $$PTEMP_2 = 1.56 - 0.07(PTEMP_1), \qquad (31)$$

where $PTEMP_1$ = the degrees average daily temperature is from 72° F, imposing that if $PTEMP_1 > 22$, $PTEMP_1 = 22$ and if $PTEMP_1 < 8$, $PTEMP = 8$,
$PTEMP_2$ = the activity factor of adult *Trichogramma* attributable to temperature,

and $$B_1 = -0.693 \div [(N)(SAREA)], \qquad (32)$$

and $$B_2 = 1 - \exp[PARSIT(B_1)](PTEMP_2)(1 - POS), \qquad (33)$$

where B_1 = index of potential parasitism,
B_2 = probability of parasitism,
POS = mortality of parasites from insecticides,
SAREA = relative search area,
and N = number of *Trichogramma* adults required to parasitize 50% of eggs in 3 days (15,000).

The parasitized eggs are subject to death by predators and other natural agents and by insecticides until the *Trichogramma* emerge. It is assumed that the parasites will live 10 days, that two female parasites will emerge from each egg, and that the number of eggs parasitized will increase as a function of search area (to account for eggs missed). The fertility rate of adult *Trichogramma* is read in as array FERATE.

Function Distribution (DISTR)

DISTR calculates the development distributions of cohorts of eggs, larvae, and pupae. A normal distribution is assumed (*22*). The standard deviations (SDEV) are calculated in subroutine GENLN as a function of temperature (*2*). Array GAUS is the cumulative distribution function for eight standard deviations centered on the mean of the normal probability distribution.

VALIDATION OF THE MODEL

Heliothis populations on corn, sorghum, and cotton were sampled at least two times a week during low populations and three or four times a week during peaks. The samples were taken by examining all plants in 6½ feet of row at six random locations in the field.

Simulations were run from April 1 to July 24, 1974, which covers the first three *Heliothis* generations. The first two *H. zea* generations at College Station oviposit primarily on corn and sorghum, and the third generation oviposits on cotton. It was assumed that the first two generations of *H. virescens* would oviposit primarily on wild hosts and that the third generation would move into cotton. Since no wild hosts were sampled, it was assumed that all eggs found on corn and sorghum were *H. zea*, an assumption verified by laboratory rearing of collected larvae. No counts of parasites or predators were made; therefore, option 3 was used in subroutines PARINP and PRDINP (fig. 5). Two simulations were run and compared with field-collected data.

Light-trap input.—Counts of *H. zea* males from two light traps (each having a 40-watt black-light lamp) located in a cornfield were used as model input from April 1 to May 20, 1974. These moths were assumed to have emerged from diapause. The next two generations were predicted and compared with actual field counts. Figure 9 shows the light-trap input converted to total eggs (April 1–May 20), the

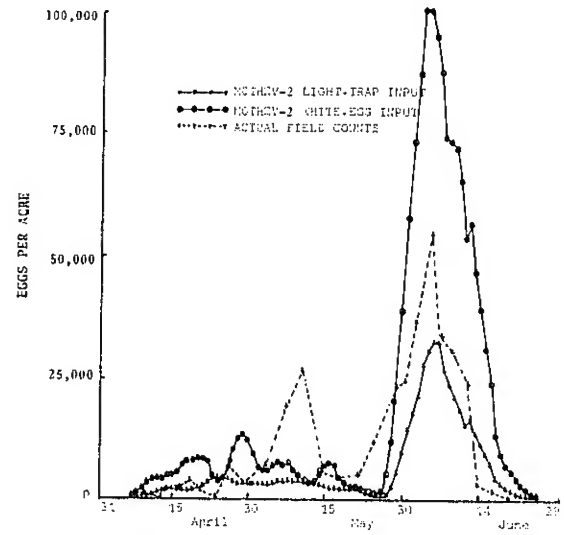


FIGURE 9.—Predicted and actual field counts of eggs. Input to model, April 1 to May 20, 1974.

predicted number of total eggs (May 21–June 29), and the number of eggs counted in the field. Actual hourly temperature was used for the entire simulation. The predicted June peak was 1 day late and the predicted number of eggs was low, the latter caused primarily by the light-trap model, probably one of the weakest parts of MOTHZV-2.

Figure 10 compares the predicted third generation of ovipositing moths migrating into cotton and the actual field count of eggs in cottonfields closest to the cornfield. The predicted moth peak was 3 days ahead of field egg peak, as expected, since eggs would require 2 or 3 days to hatch.

White-egg input.—Counts of white eggs in the cornfield from April 1 to May 20 were used as input, and predictions of the next two generations were made. Figure 9 shows the white-egg input and the predicted second generation. The predicted peak was 1 day earlier than the actual peak, and the predicted egg peak was larger than the actual field peak. (Field scouts, bear in mind, are less than accurate. Moreover, many eggs may have been removed by predators before the count.) The predicted third generation moth peak was also 3 days before the actual egg peak in cotton.

Figures 11 and 12 show predicted and actual counts of small and large larvae. The dates of these peaks are very close; however, the magnitudes of the peaks vary similarly to the egg peaks, as discussed. Further validation of assumptions concerning development periods and mortalities could alleviate differences in magnitude. It is felt that the field measurements were in error, even though very competent entomological help was used, because it is impossible to find every egg or larva and because field counts were not made every day. A factor that may affect the size of the small and large larval peaks is the subjective judgment of which group to put them in. The model apparently is

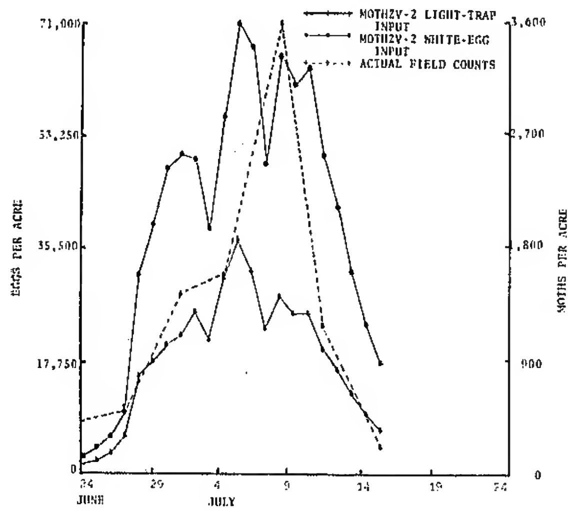


FIGURE 10.—Predicted number of moths migrating from corn and actual field counts of eggs in cotton. Input to model, April 1 to May 20, 1974.

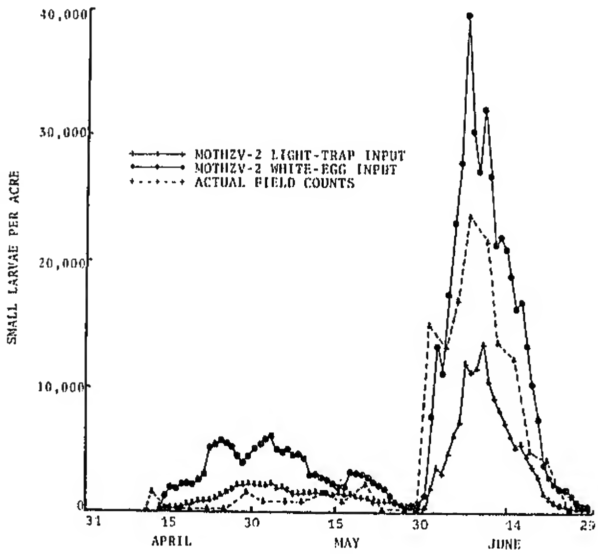


FIGURE 11.—Predicted and actual field counts of small larvae. Input to model, April 1 to May 20, 1974.

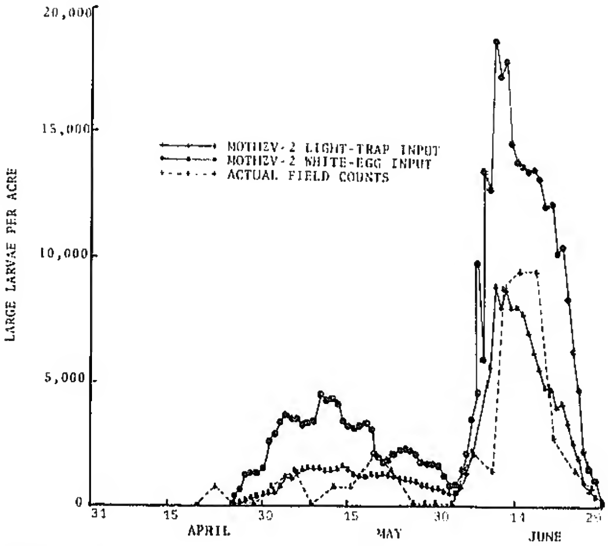


FIGURE 12.—Predicted and actual field counts of large larvae. Input to model, April 1 to May 20, 1974.

dividing them at an earlier age (1 day off) than does the field scout.

Similar results were obtained when data from previous years at College Station and Pearsall, Tex., were used. Simulation of *H. zea* in sorghum was also accomplished with similar results.

DEFINITION OF TERMS

Main Program

ADMOON	Moonlight adjustment calculated for each day.
ADTS	Number of adults migrating on each day of simulation plus the number that migrated and survived previously.
ADTSMG	Average number of ovipositing adults that have migrated and survived.
AGE	Number of days moth has been ovipositing.
AP	Proportion of the eggs not hatched.
APARA	Storage of number of eggs parasitized during simulation.
APOSON	Storage of number of eggs sterilized from insecticide during simulation.
B	Used in calculation of probability of *Trichogramma* parasitism (option 4, KODE 5).
BOLLS	Calculated cotton bolls per acre.
C	Mortality probabilities.
CLOUD	Percentage of cloud cover read in for each hour.
DATX	Array of read-in data to be plotted with output.
DEATH	Natural mortalities of all stages of insects.
DEATHY	Mortality of adults the previous day.
DEGDAY	Array of degree-days required for each stage of *Heliothis* development.
EARS	Calculated corn ears per acre.
ED	Array of degree-days calculated for *Heliothis* development and cotton growth.
EDCORN	Array of degree-days calculated for corn and sorghum development.
EGGFRT	Percentage of *Heliothis* eggs that are fertile.
EGLYCR	Probability that a female will oviposit because of a crop factor.
EGLYPR	Probability that a female will oviposit because of crop and temperature factors.
EGLYTM	Average temperature (°F) during 3-hour period of maximum oviposition.
EGP	Maximum number of eggs a *Heliothis* moth will lay in 1 day.
ELPDTA	Probability that a moth is at maximum egg production.
EQELAD	Relative number of female moths considered to be ovipositing at maximum rate.
FACTAA, FACTBB	Factors for averaging migration of moths from fields of the same crop.
FACTD	Calculated light-trap factor to correct trap catch to moths per acre.
FM	Array of moonlight adjustment factors.
FOODFK	Nutritional factor affecting development time of *Heliothis*.
HEADS	Calculated heads of sorghum per acre.
IDX	Used for plotting DATX.
IEND	Number of days a moth will produce eggs.
IFIRST	Day number of first day of simulation (Julian).
IFISTT	First day of temperature data to be read in and degree-days calculated (Julian).
IFRUIT	Day number first silk appears in corn (Julian).
IGEN	Array containing calculated average development times for all stages of *H. zea* and *H. virescens*.
IGENV	Array containing calculated average development times for all stages of *H. virescens*.
IGENZ	Array containing calculated average development times for all stages of *H. zea*.
IGKODE	Plot code.
IH	Code for *H. zea*.
ILAST	Day number of last day of simulation (Julian).
ILASTC	Day number of last day of input to model (Julian).
ILASTT	Last day of temperature input and degree-days calculated (Julian).
IPEAK	Number of days it takes an ovipositing moth to reach maximum egg production.
IPX	Code for double 3-day moving average of migrating moths.
ITOP	Number of days moth will be at maximum egg production.
IV	Code for *H. virescens*.
IXBAR	Mean length of pupal development time in days.
JFIRST, JLASTC	Variables to flag feedback of moths.

KKODE Index of type of input to model (eggs or moths).

KODE Code read in that flags the option wanted.

KRUN Code of a particular simulation.

KTRAP Index of type of input to model (eggs or moths).

LLPOP Temporary storage of field population of 1-day-old large larvae.

LX Mean length of development time for small larvae in days.

NITMIN Average nighttime temperature (°F).

NN Variable used to flag day that simulation is at IFRUIT or past.

NPLOT Plot code.

PARSIT Calculated percentage of parasitism of eggs and larvae for each day of simulation.

PCTCRP Percentage of the area in corn, sorghum, cotton, pasture, and other crops.

PCTMG Maximum percentage of the adult population that would migrate out of the crop on any one day.

PDERTE Predator rating for egg predators.

PDLRTE Predator rating for larval predators.

POAPOP Temporary storage of field population of 1-day-old ovipositing adults.

POP Temporary storage of *Heliothis* eggs.

POS Read-in array containing daily mortality of *Heliothis*, predators, and parasites attributable to insecticide treatments.

PP Temporary storage of field population of 1-day-old larvae.

PPOP Temporary storage of field population of 1-day-old pupae.

PRED Number of predators per acre of the seven groups of predators described in text.

PREDOR Calculated daily percentage of predation of eggs and larvae for each day of simulation.

PRMGRT Calculated percentage of adult population that will migrate on any one day.

PTEMP Used in calculation of probability of *Trichogramma* parasitism (option 4, KODE 5).

S Scale factor 1 for plots.

SAREA Relative plant area searched by *Trichogramma* (arbitrary scale).

SDEV Array of calculated standard deviations of development time for eggs, larvae, and pupae attributable to temperature.

SEXRTO Sex ratio of adults (males+1)/(females +1).

SITES Number of sites available for oviposition.

SLPOP Temporary storage of field population of 1-day-old small larvae.

SQUARE Calculated cotton squares per acre.

SRVIVE Number of fertile eggs remaining in population after all mortalities.

SS Scale factor 2 for plots.

T Total survival probability of small larvae.

TCLOUD Percentage of cloud cover during time of maximum oviposition.

TEMAVG Average air temperature on day of simulation (°F).

TINF Total infertile eggs.

TIMEA Array of expected or measured high and low temperatures.

TOTAL Array for storing total *Heliothis* populations of various stages.

TOTMGS Total number of ovipositing adults that migrate and survive.

TOT9 Percentage of eggs parasitized during simulation.

TP Number of eggs parasitized on any one day.

TRUN Average temperature during oviposition period (°F).

TT Total probability of something surviving.

TPP Number of eggs sterilized on any one day.

XBAR Day number that the mean number of eggs hatch (Julian).

XSD Standard deviation of egg hatch.

ADULT

FACTK Temperature effect on adult longevity.

CANBAL

ATE Percentage of small *H. zea* larvae cannibalized on sites with a large larvae on a given day.

ATEUP Total number of small *H. zea* larvae cannibalized.

CANLAR Number of small *H. zea* larvae cannibalized by other small larvae.

POP Number of surviving small *H. zea* larvae.

PRBLAR Probability of a large *H. zea* larva being on a site on a given day.

PRBNEW Probability of a small *H. zea* larvae being on a site on a given day.

S Number of sites available for *H. zea* larvae.

XBAR Average number of small larvae per site.

XPOP Total number of small larvae cannibalized from this cohort.

CROP

A20, A21, A22 Coefficients for calculating egg-laying probability on corn during silking period.

A30, A31, A32, A33 Coefficients for calculating egg-laying probability on corn before first silk appears.

A40, A41, A42 Coefficients for calculating egg-laying probability on corn after silking period.

AM20, AM21, AM22 Coefficients for calculating egg-laying probability on sorghum after boot stage.

AM30, AM31, AM32, AM33 Coefficients for calculating egg-laying probability on sorghum before boot stage.

DD — Degree-days required for corn or sorghum to develop from IA to peak silk or head.
DDA — Degree-days from corn and sorghum emergence to IA.
DDB — Degree-days from first square to first boll in cotton.
DDF — Degree-days from IA to IF in corn and sorghum.
DDM — Degree-days from first boll to maturity in cotton.
DELTAX — Percentage of crop development per day.
DISTS — Percentage of eggs hatched.
IA — Day number when crop becomes attractive to *Heliothis* (Julian).
IE — Day number when crop emerges (Julian).
IF — Day number when first fruit appears (Julian).
IM — Day number when crop becomes fully mature (Julian).
IP — Day number when crop planted (Julian).
KCROP — Set to value of KODE 11 (crop).
NATRAC — Day number when crop becomes attractive to *Heliothis* (Julian).
PLANTS — Number of plants per acre.
S — Factor used to calculate normal distribution for development of fruit.
TP — Factor used to calculate normal distribution for development of fruit.
YIELD — Estimated yield of cotton bales per acre.
YIELDB — Calculated peak number of bolls.
YIELDS — Calculated peak number of squares.

DISTR

GAUS, GAUS1, GAUS2 — Arrays of accumulated normal distributions used to vary development time of *Heliothis*.

EGGINP

B — Number of *H. zea* eggs in field on first day of simulation.
BFMALE — Number of *H. zea* females.
BMALE — Number of *H. zea* males.
C — Number of *H. virescens* eggs.
CFMALE — Number of *H. virescens* females.
CMALE — Number of *H. virescens* males.
IDD — Used for calculation of missing egg data.
L — Set to code of type of input (eggs or moths).
X — Adjustment factor for total egg input.
XDL1, XDL2 — Used for calculation of missing egg data.
XEGG — Used for adjustment of nutritional factor for sorghum.

FLDPOP

A1, A2, A3 — Coefficients used in temperature adjustment of light-trap catches.
E — Efficiency of light trap.
F — Base factor used in temperature adjustment of light-trap catches (26.7° C).
FD — Average distance (feet) a moth can fly in 1 night.
F1 — Factor used in temperature adjustment of light-trap catches.
IN — Insect species code.
IPX — Code for locating light-trap data for double 3-day moving average.
R — Effective radius (feet) of light trap.

GENLN

A1, A2, A3 — Coefficients for calculation of standard deviations in *Heliothis* development times.
EDICK — Accumulated degree-days at start of *Heliothis* development.
IGENX — Used in calculation of *Heliothis* development times.
IKODE — Flags generation length calculations so that calculation of multiple simulations of same weather data will not be repeated.
IN — Insect species code.
IX — Used in calculation of *Heliothis* development time.
P — Percentage of difference in development time of *H. zea* and *H. virescens*.
X — Standard deviations for 1 day.

GRAPH

B — Used for calculation of variable format.
DIGIT, DIGIT1, DIGIT2, — Arrays used for plotting.
INSECT — Array used for plot headings and identification.
ISTAGE — Array used for plot headings and identification.
ISTG — Used to calculate variable scale factors and printout.
K — Used for calculation of variable format.
KSTG — Used to calculate variable scale factors and printout.
NSCALE — Used to calculate variable scale factors and printout.
SCALE — Used to calculate variable scale factors and printout.
SXV — Code for *H. virescens*.
SXZ — Code for *H. zea*.
SXZV — Code for *H. zea* and *H. virescens*.
SX1 — Used to calculate variable scale factors and printout.
VFA — Variable format used to plot data.
VFB — Variable format used to plot data.

MIGRAT

XD — Day number crop becomes completely unattractive to *Heliothis* (Julian).
XM — Day number crop becomes mature (Julian).

MOON

A — Set to day number of first full moon (Julian).
B — Day number of simulation (Julian).
J — Phase-of-moon code.

PARINP

B, FX — Used to calculate percentage of parasitism.
L — Set to parasitism code (option).
N — Number of parasites per acre required to obtain 50% parasitism.
OLARPA — Number of naturally occurring parasites of *Heliothis* larvae per acre.
OTHERS — Number of naturally occurring parasites per acre.
PA — Percentage of maximum parasitism of eggs and larvae.
PEND — Last day of parasites in crop (Julian).
PDOWN — Start of downtrend of parasites (Julian).
PMAXI — First peak of parasites (Julian).
PMINI — Start of buildup of parasites (Julian).
POTHRS — Probability of parasitism by naturally occurring parasites.
PTRICH — Probability of parasitism by *Trichogramma*.
TRICH — Number of released *Trichogramma* per acre.
X — Probability of egg parasitism.
Y — Probability of larval parasitism.

PRDINP

ALB — Number of lady beetles per acre (specifically for data collected at Pecos, Tex.).
CALLOP — Number of callops per acre (specifically for data collected at Pecos, Tex.).
CHA — Number of *Chrysopa* adults per acre (specifically for data collected at Pecos, Tex.).
CHL — Number of *Chrysopa* larvae per acre (specifically for data collected at Pecos, Tex.).
CHRYSP — Number of released *Chrysopa* per acre.
HEMP — Number of Hemiptera per acre (specifically for data collected at Pecos, Tex.)
IFF, ILL — Used for calculating number of predators when actual counts are not available.
NE — Number of egg predators needed per acre to obtain 50% predation when search area=1.0.
NL — Number of larval predators needed per acre to obtain 50% predation when search area=1.0.
OTHEGG — Number of naturally occurring egg predators per acre.
OTHLAR — Number of naturally occurring larval predators per acre.
PCHRYS — Probability of predation by released *Chrysopa*.
POTHRS — Probability of predation by naturally occurring predators.
SP — Number of spiders per acre (specifically for data collected at Pecos, Tex.).
SPID — Number of spiders per acre.
X — Probability of predation of eggs.
Y — Probability of predation of small larvae.
Z — Probability of predation of large larvae.

SMOOTH

IP — Factor used in double 3-day moving average.
IXF — First day of smoothed data.
S — Factor used in double 3-day moving average.
SM — Equivalent array used to calculate double 3-day moving average.

SPRAY

P — Percentage of mortality of *Heliothis* stages, predators, and parasites on any one day.

TEMP

DAYLN — Number of hours of daylight on each day of simulation.
ET — Minimum temperature (°F) for *Heliothis* development.
IEGG — First hour of maximum oviposition after sunset.
T1 — Minimum temperature (°F) for corn and sorghum development.
T2 — Maximum temperature (°F) for corn and sorghum development.
TEM — Effective hourly degree-days for *Heliothis*.
TEMOVR — Number of degrees hourly temperature (°F) is over 92.
THP — Actual or expected daily high temperature (°F).
TLP — Actual or expected daily low temperature (°F).
TM — Actual or calculated hourly temperature (°F).

TRKGRM

FERATE — Fertility rate of *Trichogramma*.
IAGE — Age of *Trichogramma* adults in days.
K — Mean development time for *Trichogramma* in days.
TS — Keeps track of number of parasitized *Heliothis* eggs.
X — Mortality factor.

INPUT REQUIREMENTS

Device 05 or
SYSIN: KODE
FORMAT (20I4)

KODE	Col. No.		Description
1	4	0	Leaves population input the same as in previous run.

		1	Reads in moths (total number).
		2	Reads in eggs (1-day-old).
		3	Reads in moths (male and female).
		4	Reads in eggs (all ages).
		5	Migration used as input.
		6	Reads in total eggs with missing data.
		7	Reads in 0- to 1-day-old eggs with missing data.
2	8	0	Temperature stays the same as in previous run; generation length stays same.
		1	Reads in hourly temperature.
		2	Temperature stays the same as in previous run; generation length can be changed.
		3	Reads in daily maximum and minimum temperature.

Note: Always read in temperature for at least 1 day before and 30 days after time of simulation of crop or insect.

3	12	0	No moonlight effect on insect.
	10–12	xxx	Day number of first full moon in January (add 1 for leap year).
4	16	0	No mortalities from insecticides.
		1	Reads in insecticide mortality.
		2	Leaves input the same as in previous run.
5	20	0	Leaves input the same as in previous run (0 to 1st run).
		1	Reads in maximum parasitism.
		2	Reads in number of parasites on each day.
		3	Reads in percentage of parasitism for each day.
		4	Reads in number of *Trichogramma* and generates future populations.
6	24	0	Migration not calculated.
		1	Migration away from crop.
		2	Migration into crop as input.
7	26–28		Not used.
8	32	0	No smoothing of data.
		1	Smooths trap catch by a double 3-day moving average.
9	36	0	No adjustment in trap catch.
		1	Adjusts trap catch to moths per acre.
		2	Uses same adjustment as previous run.
10	38–40	xxx	Day number that model should run to.
11	44	1	Corn.
		2	Sorghum.
		3	Cotton.
12	48	0	Leaves predator input the same as in previous run.
		1	Reads in maximum predation.
		2	Reads in number of predators per day.
		3	Reads in precentage of predation on each day.
		4	Reads in number of predators with incomplete data.
13	52	0	Leaves natural mortalities the same as in previous run.
		1	Reads in natural mortalities, egg fertility, and the maximum number of eggs per moth per day.
14	56	0	Leaves crop phenology the same as in previous run.
		1	Reads in crop phenology.
15	60	0	Leaves migration the same as in previous run.
		1	Calculates migration.
16	62	0	Log plot of data.
		1	Linear plot of data.
		2	No plot.
	63–64	xx	Number of plots wanted.
17	68	0	No cannibalism.
		1	Calculates cannibalism of larvae.
18	72	1	This run is for *H. zea* and *H. virescens*.
		2	This run is for *H. virescens* only.
		3	This run is for *H. zea* only.
19	76	0	No cloud cover input, clear sky assumed.
		1	Input cloud cover and use.

Device 05 or
SYSIN: Mortalities, egg fertility, and egg laying
KODE (13) = 1 or more
FORMAT (2 (6F4.3, F4.0))

Column No.	Description
1–4	*H. zea*: Natural mortality of eggs (%÷100).
5–8	*H. zea*: Natural mortality of 1- to 3-instar larvae.
9–12	*H. zea*: Natural mortality of 4- and 5-instar larvae.
13–16	*H. zea*: Natural mortality of pupae.
17–20	*H. zea*: Natural mortality of adults.
21–24	*H. zea*: Egg fertility.
25–28	*H. zea*: Maximum number of eggs per female per day.
29–32	*H. virescens*: Natural mortality of eggs.
33–36	*H. virescens*: Natural mortality of 1- to 3-instar larvae.
37–40	*H. virescens*: Natural mortality of 4- and 5-instar larvae.
41–44	*H. virescens*: Natural mortality of pupae.
45–48	*H. virescens*: Natural mortality of adults.
49–52	*H. virescens*: Egg fertility.
53–56	*H. virescens*: Maximum number of eggs per female per day.

Device 05 or
SYSIN: Days of population data on device 11
KODE (1) = 1 or more
FORMAT (2I4)

Column No.	Description
1–4	First day of initial population data to be read in.
5–8	Last day of initial population data to be read in.

Device 05 or
SYSIN: Days of temperature data on device 15 and device 16
KODE: (2) = 1 or 3
FORMAT (2I4)

Column No.	Description
1–4	First day of temperature data to be read in and degree-days calculated.
5–8	Last day of temperature data to be read in and degree-days calculated.

Note: Reading switches automatically to device 16 when end-of-file encountered on device 15. Sufficient days of input should be allowed for crop growth and multiple-run situations.

Device 05 or
SYSIN: Crop phenology
KODE (14) = 1
FORMAT (4I6, F6.0, I6, 5F3.2)

Column No.	Description
1–6	Day number of planting date of crop, IP.
7–12	Day number of emergence date of crop, IE.
13–18	Day number when first fruit appeared, IF.
19–24	Day number when crop became mature, IM.
25–30	Number of plants per acre.
31–36	Day number when crop becomes attractive to moths, IA.
37–39	Percentage of the area in corn.
40–42	Percentage of the area in sorghum.
43–45	Percentage of the area in cotton.
46–48	Percentage of the area in pasture.
49–52	Percentage of the area in other crops.

Device 05 or
SYSIN: Maximum parasitism
KODE (5) = 1 or 4
FORMAT (2F6.3)

Column No.	Description
1–6	Maximum parasitism of eggs (%÷100). Set to zero if KODE (5) = 4.
7–12	Maximum parasitism of 1- to 3-instar larvae (%÷100).

Device 05 or
SYSIN: Maximum predation
KODE (12) = 1
FORMAT (2F6.3)

Column No.	Description
1–6	Maximum predation of eggs (%÷100).
7–12	Maximum predation of 1- to 3-instar larvae (%÷100).

Device 05 or
SYSIN: Plot control
KODE (16) less than 200
FORMAT (36I2), 1 card required for each plot wanted (10 curves per plot maximum)

[Put a 1 in column indicated for desired plot]

Scale[1]	Information plotted	Column number *H. zea*	*H. virescens*	Both spp.
1	Total eggs	2	26	50
1	Small larvae (1- to 3-instar)	4	28	52
1	Large larvae (4- to 5-instar)	6	30	54

[Put a 1 in column indicated for desired plot]

Scale[1]	Information plotted	Column number *H. zea*	*H. virescens*	Both spp.
1	Pupae	8	32	56
2	Preovipositing adults	10	34	58
2	Ovipositing adults	12	36	60
2	Input data (as adults)	14	38	62
2	Migrating adults	16	40	64
1	Parasitized eggs	18	42	66
2	Predicted ovipositing adults equivalents	20	44	68
1	Other variable scale (1)	22	46	70
2	Other variable scale (2)	24	48	72

[1] 1 based on maximum eggs; 2 based on maximum preovipositing adults.

Device 05 or SYSIN: KRUN (always required) FORMAT (I3)

KRUN designates the status of additional runs to be made. Values greater than zero indicate that additional runs are to be made, and a value of zero (blank) indicates that the present input is the final run to be made.

If the migration outputs from several runs are to be averaged for input to a second crop, special sequential values should be coded as follows: for corn, 11, 12, 13, . . . 19; for sorghum, 21, 22, 23, . . . 29; for cotton, 31, 32, 33, . . . 39.

KRUN indicates the field number associated with the data following the KRUN card. The value of KRUN for the first data set entered is assigned automatically by the program depending on the crop type selected. For a series of three corn fields and two sorghum fields followed by a cotton field the input sequence would be as follows: corn data 1 with KRUN=12, corn data 2 with KRUN=13, corn data 3 with KRUN=21, sorghum data 1 with KRUN=22, sorghum data 2 with KRUN=31, cotton data with KRUN=0. The average migration from the three corn fields would then be added to the average migration from the sorghum and used as input to the cotton with the proper selection of constants on the KODE cards. If independent multiple runs are to be made, values of KRUN from 1 to 9 should be used. No averaging of output will take place.

Device 11: Moth or egg input

A. KODE (1)=1: Moth input (initial population= males+females)
FORMAT (I6, 4F6.1), 1 card for each day

Column No.	Description
1–6	Day number.
7–12	*H. zea*: Number of males.
13–18	*H. zea*: Number of females.
19–24	*H. virescens*: Number of males.
25–30	*H. virescens*: Number of females.

B. KODE (1)=2: Egg input (0- to 1-day-old)
FORMAT (9x, I3, 2F6.0), 1 card for each day

Column No.	Description
10–12	Day number.
13–18	*H. zea*: Number of eggs.
19–24	*H. virescens*: Number of eggs.

C. KODE (1)=3: Moth input (initial population= 2 times number of males, sex ratio calculated)
FORMAT (I6, 4F6.1), card for each day

Same as A above

D. KODE (1)=4: Egg input (all ages)
FORMAT (9x, I3, 2F6.0)

Same as B above

E. KODE (1)=5: Migration of *H. zea* moths from corn or sorghum or both; moth input of *H. virescens* if KODE (18)=1 or 2
FORMAT (I6, 12x, 2F6.1)

Same as A above; enter zero for *H. zea*.

F. KODE (1)=6: Egg input (all ages) with missing data
FORMAT (18x, 2F6.0, I3), 1 card for each day that data are available; computer will calculate missing days. Cards must be in order by date.

Column No.	Description
19–24	*H. zea*: Number of eggs.
25–30	*H. virescens*: Number of eggs.
37–39	Day number.

G. KODE (1)=7: Egg input (0- to 1-day-old) with missing data

Same as F above

Device 12: Insecticide mortalities FORMAT (I6, 14F4.3), 1 card for each day there is mortality

Column No.	Description
1–6	Day number.
7–10	*H. zea*: Parasites (%÷100).
11–14	*H. zea*: Predators.
15–18	*H. zea*: 1- to 3-instar larvae.
19–22	*H. zea*: 4- and 5-instar larvae.
23–26	*H. zea*: Pupae.
27–30	*H. zea*: Adults.

31–34	*H. zea*:	Eggs.
35–38	*H. virescens*:	Parasites.
39–42	*H. virescens*:	Predators.
43–46	*H. virescens*:	1- to 3-instar larvae.
47–50	*H. virescens*:	4- and 5-instar larvae.
51–54	*H. virescens*:	Pupae.
55–58	*H. virescens*:	Adults.
59–62	*H. virescens*:	Eggs.

Device 13: Parasites

A. KODE (5) = 2
FORMAT (I6, 3F6.0)

Column No.	Description
1–6	Day number.
7–12	Number of *Trichogramma* released.
13–18	Number of natural egg parasites.
19–24	Number of natural larval parasites.

B. KODE (5) = 3
FORMAT (I6, 2F6.3)

Column No.	Description
1–6	Day number.
7–12	Parasitism of eggs (% ÷100).
13–18	Parasitism of larvae (% ÷100).

C. KODE (5) = 4
FORMAT (I6, F6.0)

Column No.	Description
1–6	Day number.
7–12	Number of *Trichogramma*.

Device 14: Predators

A. KODE (12) = 2
FORMAT (9X, I3, 6F6.0, 6X, 2F6.0, 6X, F6.0) (Special format for handling 1973–74 Frio County, Tex., data.)

Column No.	Description
10–12	Day number.
13–18	Number of *Scymnus*.
19–24	Number of other Coccinellidae.
25–30	Number of other Coleoptera.
31–36	Number of *Orius*.
37–42	Number of *Geocoris*.
43–48	Number of other Hemiptera.
55–60	Number of *Chrysopa* immatures.
67–72	Number of spiders.
73–78	Number of released *Chrysopa*.

B. KODE (12) = 3
FORMAT (I6, 2F6.2)

Column No.	Description
1–6	Day number.
7–12	Predation of eggs (% ÷100).
13–18	Predation of larvae (% ÷100).

C. KODE (12) = 4
FORMAT (6X, 6F5.0, I3) (Special format for handling 1974 Pecos, Tex., data.)

Column No.	Description
7–11	Number of spiders.
12–16	Number of adult lady beetles.
17–21	Number of other Hemiptera.
22–26	Number of *Chrysopa* larvae.
27–31	Number of *Chrysopa* adults.
32–36	Number of Coleoptera.
37–39	Day number.

Devices 15 and 16: Air temperature

A. KODE (2) = 1: Read from device 15
FORMAT (2X, I3, 3X, 24F3.0): Measured hourly temperature, 1 card per day

Column No.	Description
3–5	Day number.
9–11	Average temperature from 0000 to 0100 hours.
12–14	Average temperature from 0100 to 0200 hours.
....	....
78–80	Average temperature from 2400 to 0100 hours.

B. KODE (2) = 3 or end of file on device 15: Read from device 16. Sufficient data corresponding to final day specified for temperature input on SYSIN must be provided.
FORMAT (I3, 2F3.0): Measured high and low for each day.

Column No.	Description
1–3	Day number.
4–6	Measured high temperature for day.
7–9	Measured low temperature for day.

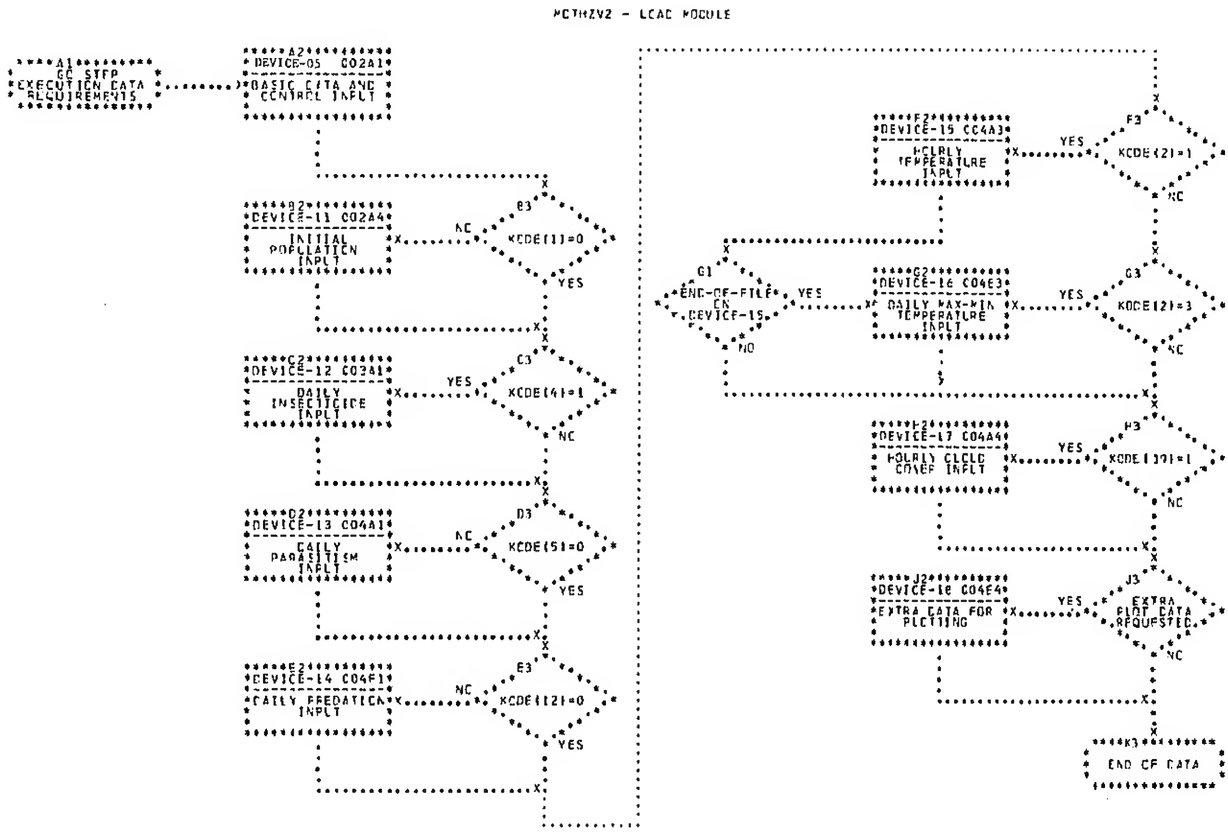
Device 17: Cloud cover

KODE (19) = 1: First and last day read in correspond to temperature data. On end-file condition program uses last data read in for remainder of days of input requested. Final card should show desired cloud conditions accordingly.
FORMAT (2X, I3, 3X, 24F3.0)

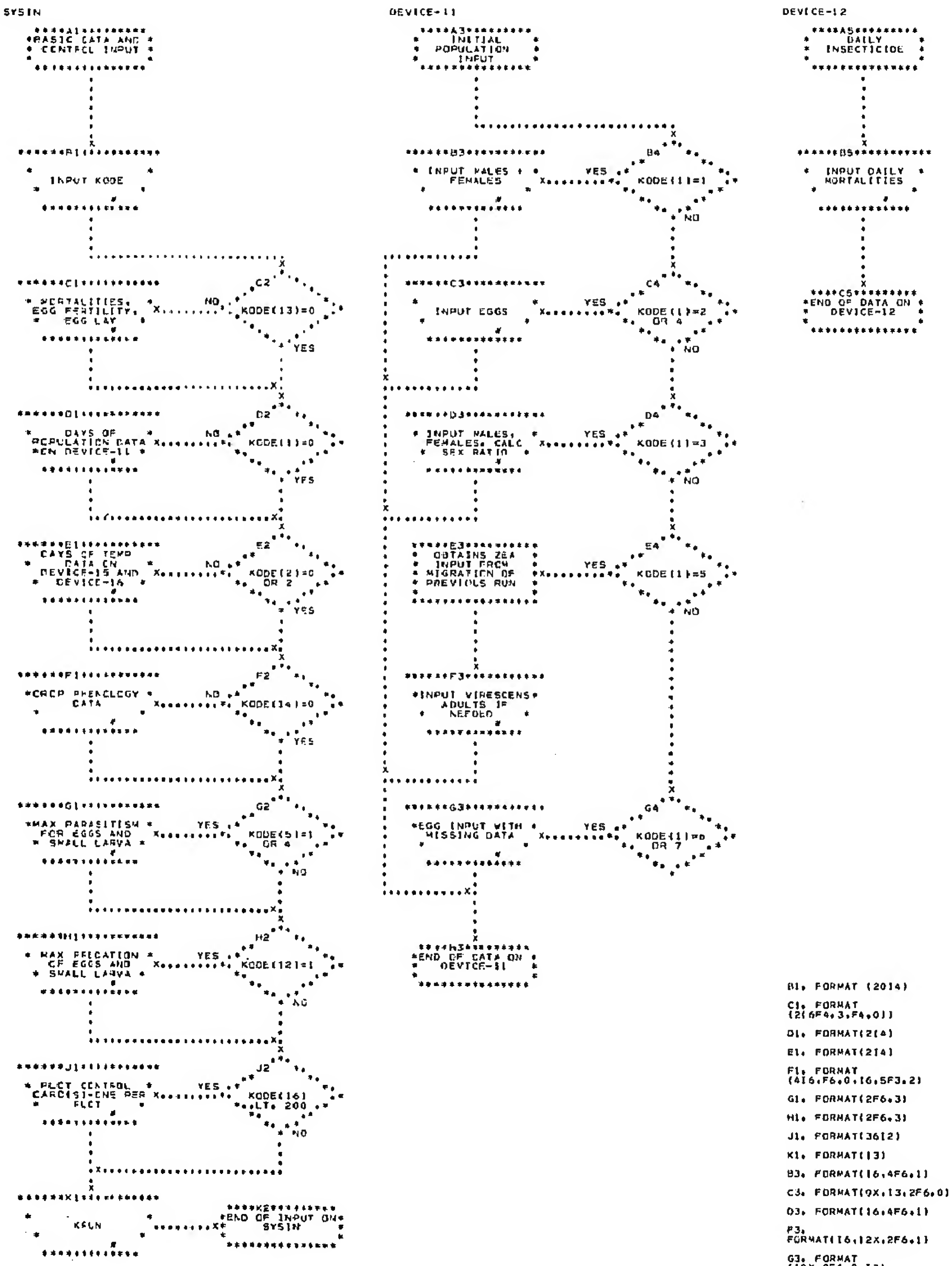
Column No.	Description
3–5	Day number.
9–11	Cloud cover from 0000 to 0100 hours.
12–14	Cloud cover from 0100 to 0200 hours.
....	....
78–80	Cloud cover from 2400 to 0100 hours.

		Column No.	Description
Device 18:	Extra data to be added to print plot for comparison with model output.	7–12	Day number.
		13–18	Data value.

FORMAT (6X, I6, F6.0)



MOTHZV2 - LOAD MODULE
INPUT REQUIREMENTS



B1. FORMAT (20I4)

C1. FORMAT (2(6F4.3,F4.0))

D1. FORMAT(2I4)

E1. FORMAT(2I4)

F1. FORMAT (4I6,F6.0,I6,5F3.2)

G1. FORMAT(2F6.3)

H1. FORMAT(2F6.3)

J1. FORMAT(36I2)

K1. FORMAT(I3)

B3. FORMAT(I6,4F6.1)

C3. FORMAT(9X,I3,2F6.0)

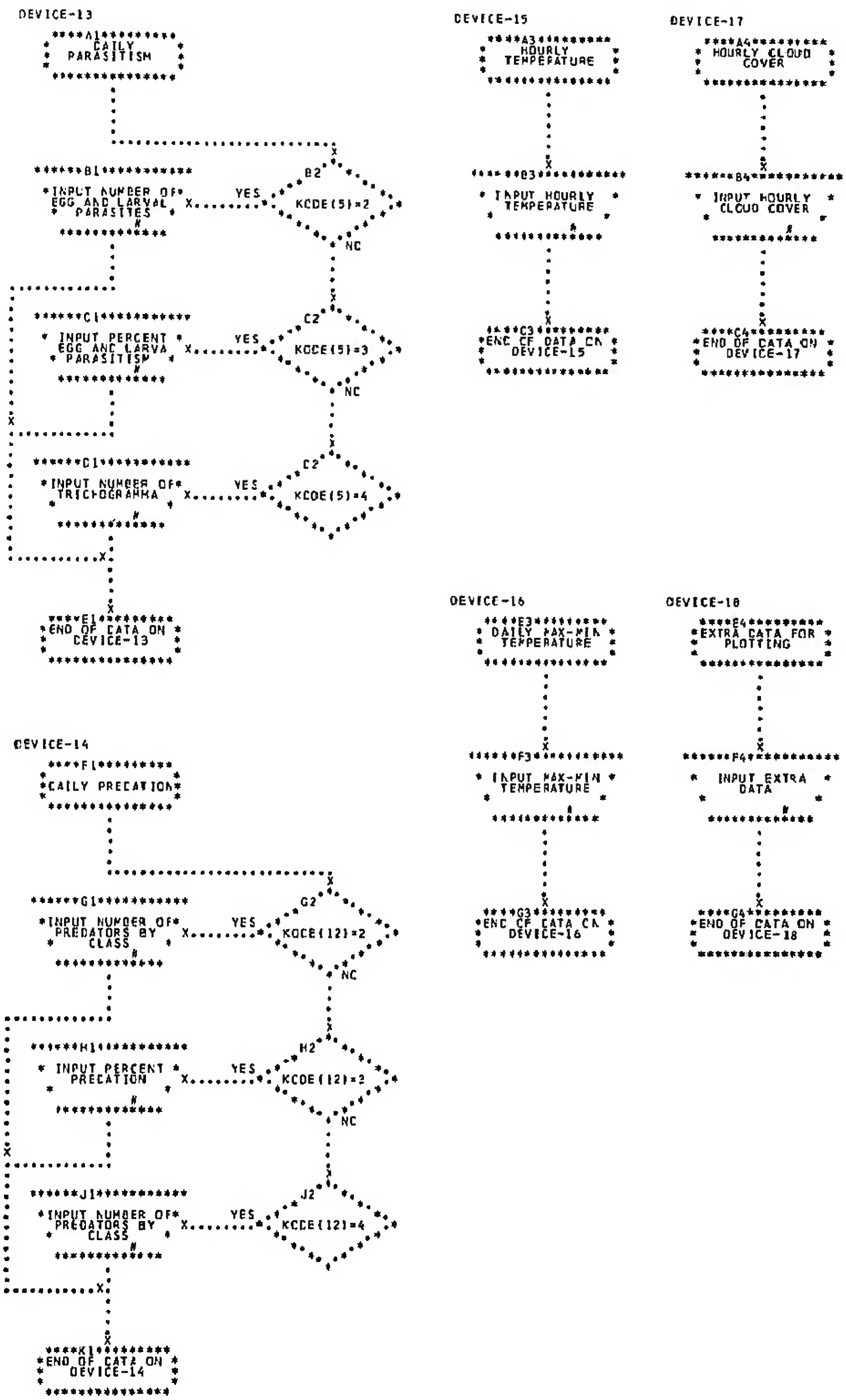
D3. FORMAT(I6,4F6.1)

F3. FORMAT(I6,12X,2F6.1)

G3. FORMAT (18X,2F6.0,I3)

B5. FORMAT(I6,14F4.3)

MOTHZV2 - LOAD MODULE
INPUT REQUIREMENTS



B1. FORMAT(I6,3F6.0)

C1. FORMAT(I6,2F6.3)

D1. FORMAT(I6,F6.0)

G1. FOR FRIO CC. DATA FORMAT(9X,I3,6F6.0,6X,2F6.0,6X,F6.0)

H1. FORMAT(I6,2F6.2)

J1. FOR PECOS DATA FORMAT(6X,6F5.0,I3)

B3. FORMAT(2X,I3,3X,24F3.0)

F3. FORMAT(I3,2F3.0)

B4. FORMAT(2X,I3,3X,24F3.0)

F4. FORMAT(6X,I6,F6.0)

PROGRAM LISTING

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C   MOTHZV 2 MODEL OF  THE HELIOTHIS ZEA AND VIRESCENS BY A. W. HARTSTACK
C   ROOM 231 AGRICULTURAL ENGINEERING BLDG. USDA ARS COLLEGE STATION,
C   TEXAS
      REAL NITMIN
      REAL SLPOP(370), LLPOP(370), PPOP(370), POAPOP(370)
      COMMON KODE(20),FACTD,SDEV(370,4),NITMIN(370),ED(370),EDCORN(300),
     ASQUARE(370),BOLLS(370),EARS(370),HEADS(370),S(4),POP(370),EGLYTM(3
     C70),IFIRST,ILASTC,IH,IV,ADMOON(370),SAREA(370),TCLOUD(370),ILAST,
     DKRUN,SEXRTO(370,2),EGPEMT(2),PCTCRP(5),IGEN(370,7,2),TEMAVG(370),
     EEQELAD(370,2),ADTSMG(370,2,2),TOTAL(370,9,2),POS(370,7,2),PARSIT
     F(370,2),PREDOR(370,2),PRMGRT(370,2),IA,IM,L,I,DEATHY,SURV,EGLYPR(
     G370,2),PLANTS,KCROP,IS,SITES(369),R,DF,EGLYCR(370,2),CANLAR,JJ,KK,
     HNN,XPOP,N,PP,IN,K,SRVIVE,X,IPX,IGKODE(12,3),DATX(370),TP,DEATH(5,2
     I),XBAR,XSD,DISTS,IFISTT,ILASTT,IE,PRBLAR,PRBNEW
      DIMENSION SS(2)
      DIMENSION ZZERO(2590),ZONE(16280),ZTWO(740),ZTHREE(1854)
      DIMENSION EGGFRT(2),EGP(2),TOTMGS(370,2),CLOUD(24)
      DIMENSION FM(30)
      DIMENSION PDERTE(7),PDLRTE(7),PRED(7)
      DIMENSION TMEA(800)
      DIMENSION DEAULT(25)
      DIMENSION DEGDAY (6,2)
      DIMENSION ADTS(370,2)
      DIMENSION PCTMG(2)
      DIMENSION SITEOC(370)
      EQUIVALENCE (ZZERO(1),SLPOP(1)),(ZZERO(371),LLPOP(1)),
     D   (ZZERO(741),PPOP(1)),(ZZERO(1111),POAPOP(1)),
     E   (ZZERO(1481),SITEOC(1)),(ZZERO(1851),TOTMGS(1,1))
      EQUIVALENCE (ZONE(1),EQELAD(1,1))
      EQUIVALENCE (ZTWO(1),ADMOON(1))
      EQUIVALENCE (ZTHREE(1),SQUARE(1))
      DO 1 I=1,370
1     TCLOUD(I)=0.0
C   INITIALIZE TO ZERO VARIABLES NOT IN COMMON.
      DO 9 I=1,2590
9     ZZERO(I)=0.0
C   INITIALIZE TO ZERO VARIABLES EQELAD THRU PRMGRT IN COMMON.
      DO 19 I=1,16280
19    ZONE(I)=C.0
C   INITIALIZE TO ONE VARIABLES ADMOON THRU SAREA IN COMMON.
      DO 29 I=1,740
29    ZTWO(I)=1.0
C   INITIALIZE TO ZERO VARIABLES SQUARE THRU POP IN COMMON.
      DO 39 I=1,1854
39    ZTHREE(I)=0.0
C   KRUN-0 MEANS THE INITIAL SIMULATION. KRUN-1 MEANS GREATER THAN 1-
C   ADDITIONAL SIMULATION. IFIRST-DAY NO. FIRST DAY OF SIMULATION. ILAST
C   -DAY NO OF FINAL DAY OF SIMULATION.
      IDX=0
      KRUN=0
C   KODE-1-20 OPTIONS.
   34 READ(5,500)(KCDE(I),I=1,20)
  500 FORMAT(20I4)
      ILAST=KODE(10)
C   IH-CODE FOR HELICTHIS ZEA- IV CODE FOR HELIOTHIS VIRESCENS.
      IH=1
      IV=2
      IF(KODE(18).EQ.2)IH=2
      IF(KODE(18).EQ.3)IV=1
      IF(KRUN.EQ.0) GO TO 7
      IF(KODE(13).EQ.0) GO TO 37
C   DEATH-NATURAL MORTALITY FOR EGGS,SMALL LARVAE,LARGE LARVAE,PUPAE,
C   ADULTS. EGGFRT-FERTILITY OF EGGS. EGPEMT-EGGS PER FEMALE MOTH.
    7 READ(5,506)((DEATH(I,J),I=1,5),EGGFRT(J),EGPEMT(J),J=1,2)
  506 FORMAT(2(6F4.3,F4.0))
      DO 38 I=IH,IV
      EGP(I)=EGPEMT(I)
   38 EGPEMT(I)=EGPEMT(I)/2.
   37 IF(KODE(1).EQ.0) GO TO 60
C   EGGIMP-SUBROUTINE FOR INPUTING INITIAL POPULATIONS. TOTAL-ARRAY OF
C   VARIOUS POPULATION STAGES. ILASTC-LAST DAY OF INITIAL INPUT DATA READ
C   IN. FACTD-LIGHT TRAP CONVERSION FACTOR. ADTSMG-ADULTS MIGRATING
C   INTO CROP. SEXRTO-SEX RATIO MALES-FEMALES. PCTCRP-PERCENTAGE OF
C   OVERALL AREA IN EACH CROP SIMULATED.
      READ(5,500) IFIRST,ILASTC
      CALL EGGINP
      IF(KRUN.EQ.0) GO TO 62
   60 KF=IFIRST-1
      DO 61 I=KF,ILAST
      SLPOP(I)=0.
      LLPOP(I)=0.
      PPOP(I)=0.
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          POAPOP(I)=0.
          CATX(I)=0.
          DO 61 K=IH,IV
          TOTMGS(I,K)=0.0
          EQELAD(I,K)=0.0
          TOTAL (I,8,K)=0.0
          TOTAL(I,9,K)=0.0
          DO 61 J=1,6
       61 TOTAL (I,J,K)=0.0
       62 CONTINUE
          IF(KODE(2).EQ.0.OR.KODE(2).EQ.2) GO TO 2
C     READS IN TEMPERATURE
C     TEMP-SUBROUTINE USED TO READ IN TEMP AND OTHER VARIABLES.
C     ED-ACCUMALATED DEGREE DAYS USED FOR INSECT + COTTON- TEMAVG-AVERAGE
C     TEMP PER DAY. EDCORN-ACCUMALATED DEGREE DAYS FOR CORN.
C     EGLYTM-TEMP DURING THE PERIOD WHEN THE MOTH LAYS EGGS.
C     NITMIN-AVERAGE TEMP DURING THE NIGHT- TCLOUD-AVERAGE CLOUD COVER
C     DURING THE PERIOD WHEN THE MOTH IS LAYING EGGS.
          READ (5,500) IFISTT,ILASTT
          CALL TEMP
C     GENLIN-SUBROUTINE USED FOR CALCULATING DEVELOPING TIMES FOR ALL
C     STAGES OF INSECT. IGEN- ARRAY OF DEVELOPMENT TIMES FOR VARIOUS STAGES
C     OF INSECT. IGENZ- ARRAY OF DEVELOPMENT TIMES FOR HELIOTHIS ZEA.
C     IGENV-ARRAY FOR DEVELOPMENT TIMES FOR HELIOTHIS VIR.
C     SDEV-STANDARD DEVIATION OF DEVELOPMENT TIMES VARIOUS STAGES.
2         CALL GENLN
C     CROP-SUBROUTINE FOR CALCULATING CROP PHENOLOGY. EGLYPR-EGGLAY
C     PROBABILITY.
C     PLANTS-NO. OF PLANTS PER ACRE.
C     SQUARE-NO. OF SQUARES PER ACRE.
C     BOLLS- NO OF BOLLS PER ACTE.  EARS-  NO OF EARS PER ACRE.
C     HEADS- NO OF SORGHUM  HEADS PER ACRE.  KCROP- KODE FOR CROP.
C     IA-CODE FOR 1ST ATTRACTNESS OF CROP. IM-DAY WHEN CROP REACHES
C     MATURITY.
C     SAREA-SEARCH AREA FOR PARASITES AND PREDATORS. IS-DAY NO WHEN CROP
C     IS MAX ATTRACTANCE. SITES-NO. OF SITES FOR EGG LAYING.
C     DF-DISPERSION FOR NEGATIVE BINOMIAL. EGLYCR-ATTRACTANCE OF CROP FOR
C     EGG LAY.
          CALL CROP
          IF(KODE(5).EQ.0) GO TO 33
C     PARIMP-SUBROUTINE FOR CALCULATING PARASITIZATION.
C     PARSIT-PERCENT PARASITIZATION CALCULATED.
32        CALL PARINP
       33 IF(KODE(12).EQ.0) GO TO 35
C     PRDIMP-SUBROUTINE FOR PREDATION INPUT. PREDOR- PERCENT PREDATION
C     CALCULATED.
          CALL PRDINP
       35 CONTINUE
        5 IF(KODE(3).EQ.0) GO TO 3
C     MOON-SUBROUTINE FOR CALCULATING REDUCTION OF EGG LAY DUE TO
C     MOONLIGHT.
C     ADMOON-PERCENT REDUCTION OF EGG LAY OF MOONLIGHT CALCULATED.
          CALL MOON
        3 CONTINUE
C     SPRAY-SUBROUTINE FOR INPUTING INSECTICIDE MORTALITY.
C     POS-PERCENT MORTALITY DUE TO INSECTICIDE.
          CALL SPRAY
       63 IF(KODE(9).EQ.0) GO TO 36
C     FLDPOP-SUBROUTINE FOR CONVERTING LIGHT TRAP CATCH TO MOTHS PER ACRE.
C     FACTD-CALCULATED FACTOR FOR CONVERTING LIGHT TRAP CATCH.
          CALL FLDPOP
          GO TO 64
C     FACTD-EQUALS 1 IF INPUT IS NOT LIGHT TRAP CATCHES.
       36 FACTD=1.0
       64 CONTINUE
C     NEXT SERIES OF CARDS PRINT OUT READ IN AND CALCULATED INPUT DATA-
C     FOR USE IN SIMULATION.
          IF(KODE(18).EQ.1)WRITE(6,708)
          IF(KODE(18).EQ.2)WRITE(6,710)
          IF(KODE(18).EQ.3)WRITE(6,707)
      707 FORMAT(' INPUT FOR THE MODEL HAS BEEN HELIOTHIS ZEA ONLY')
      708 FORMAT('  INPUT FOR THE MODEL HAS BEEN HELIOTHIS ZEA AND VIRESCEN'
         X)
      710 FORMAT('  INPUT FOR THE MODEL HAS BEEN HELIOTHIS VIRESCEN ONLY')
          WRITE(6,7070) IFIRST,ILASTC
 7070     FORMAT(' ','INPUT READ FROM',I4,' TO ',I4)
        4 WRITE(6,75)FACTD,KRUN,EGGFRT(1),EGGFRT(2),EGP(1),EGP(2),PLANTS
       75 FORMAT(' ',2X,'FACTD=',F6.3,2X'RUN NO.=',I3,'ZEA EGGFRT=',F6.3,'VI
         XRS EGGFRT=',F6.3,/,' ZEA EGGS/MOTH =',F6.0,' VIRS EGGS/MOTH=',F6.0
         X,'PLANTS/ACRE=',F6.0,/)
          WRITE(6,7700) IE,IA,IS,IM
 7700     FORMAT(' ','CROP PHENOLOGY: IE=',I3,',IA=',I3,', IF=',I3,',IM=',I3/
         C)
          WRITE(6,76)
       76 FORMAT(' DAY NO. EGGPAR 1-3PAR EGGPRD 1-3PRD TCLOUD NITMIN TEMAVG
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```
     2 ADMOON EGLYTM SQUARES BOLLS  EARS   HEADS  SAREA')
      DO 70 I=IFIRST,ILAST
      WRITE(6,79)I,(PARSIT(I,J),J=1,2),(PREDOR(I,J),J=1,2),TCLOUD(I),NIT
     2MIN(I),TEMAVG(I),ADMOON(I),EGLYTM(I),SQUARE(I),BOLLS(I),EARS(I),HE
     3ADS(I),SAREA(I)
   79 FORMAT(' ',I7,4F7.3,3F7.1,F7.3,F7.1,4F7.0,F7.1)
   70 CONTINUE
      DO 72 IN =IH,IV
      WRITE(6,603)
  603 FORMAT(' ',//,30X,'NATURAL MORTALITY',/,'    EGGS 1-3 LARVAE 4-5 L
     XARVAE    PUPAE',6X,'ADULTS')
      WRITE(6,604) (DEATH(I,IN),I=1,5)
  604 FORMAT(12F10.3)
      WRITE(6,77)
   77 FORMAT('1 DAYNO. POSPAR POSPRD POS1-3 POS4-5 POSPUP POSADT POSEGG
     2EGG 1-3 4-5 PUP ADP ADO E-E EGLYPR EGLYCR PRMGRT SEXRTO')
      IF(IN.EQ.1)WRITE(6,605)
      IF(IN.EQ.2)WRITE(6,606)
      DO 72  I=IFIRST,ILAST
      WRITE(6,78)I,(POS(I,J,IN),J=1,7),(IGEN(I,J,IN),J=1,7),       EGLYP
     2R(I,IN),EGLYCR(I,IN),PRMGRT(I,IN),SEXRTO(I,IN)
   78 FORMAT(' ',I7,7F7.3,7I4,3F7.3,2F7.2)
   72 CONTINUE
      WRITE(6,81)
   81 FORMAT('     KK     I     SITES   PRBLAR PRBNEW')
  720 CONTINUE
C   IFRUIT-ESTIMATED TO BE 9 DAYS PRIOR TO THE LAST SILKS TO APPEAR.
C   (CORN ONLY)
      IFRUIT=IM-9
      IF(KODE(1).EQ.0) KODE(1)=KKODE
      KKODE=KODE(1)
C   START OF MAIN POPULATION LOOP.
      DO 200 IN =IH,IV
C FOODFK-NUTRIENT VALUE OF CROP CORN LEAVES-1.0-MILO 1.1/ CORN EARS .65
C   COTTON-1.0 FOR ZEA---ALL CROPS 1.0 FOR VIRESCEN
C   FOODFK-VARIABLE USED TO INCREASE OR REDUCE LENGTH OF LARVAE
C   DEVELOPMENT.
      FOODFK=1.1
      IF(KCROP.EQ.1) FOODFK=1.
      IF(IN.EQ.2) FOODFK=1.0
      IF(KCROP.EQ.3) FOODFK=1.0
C   NN-VARIABLE USED TO FLAG WHEN DAY OF SIMULATION IS IFRUIT OR
C   GREATER (CORN ONLY).
      NN=0
      TSITOC=0.
      JFIRST=IFIRST
      JLASTC=ILASTC
C   MAIN POPULATION LOOP.
      DO 200 K=IFIRST,ILAST
  521 CONTINUE
C   KTRAP-CODE NAME OF TYPE OF INPUT.
      KTRAP=KODE(1)
      IF(KODE(6).EQ.2)GO TO 51
      IF(K.GT.ILASTC) GO TO 50
      GO TO (52,520,52,520,8,520,520),KTRAP
      GO TO 8
C   POP NO 0-1 DAY OLD EGGS. EQELAD-NUMBER OF EQUIVALENT EGG LAYING
C   ADULTS.
C   TOTAL-(K,7,IN) INPUT DATA CONVERTED TO MOTHS PER ACRE.
C   K-DAY NUMBER  OF SIMULATION. IN-SPECIES OF INSECT.
C   STATEMENT NO 51 USED ONLY WHEN INPUT IS MIGRATING MOTHS.
   51 POP(K-1)=(EQELAD(K-1,IN)+(TOTAL(K-1,7,IN)*EGLYPR(K-1 ,IN)))*EGPEMT(
     1 IN)*ADMOON(K-1)
      GO TO 8
C   STATEMENT 50 USED ONLY WHEN DAY OF SIMULATION IS PAST LAST DAY
C   OF INPUT.
C   GENERATED EQELAD IS USED AS INPUT.
   50 POP(K-1)=EQELAD(K-1,IN)*EGPEMT(IN)*ADMOON(K-1)*EGLYPR(K-1,IN)
      GO TO 8
C   STATEMENT 52 IS USED WHEN INPUT IS LIGHT TRAP CATCHES.
   52 POP(K-1)=TOTAL(K-1,7,IN)*EGPEMT(IN)*EGLYCR(K-1,IN)
      GO TO 8
C   STATEMENT 520 IS USED WHEN INPUT IS EGGS.
  520 POP(K-1)=TOTAL(K-1,7,IN)*EGPEMT(IN)
C   APOSON-STORAGE OF NUMBER EGGS STERILIZED FROM INSECTICIDE.
C   APARA-STORAGE OF NUMBER OF EGGS PARASITIZED.
    8 CONTINUE
      APOSON=0
      APARA=0
      TOTPAR=0
      TOTPOS=0
      IF(POP(K-1).LT.1.)GO TO1100
C   XBAR-DAY NUMBER THAT THE MEAN NUMBER OF EGGS HATCHED.  XSD-SDEV-(K,1)
C   STANDARD DEVIATION OF EGGS HATCHED DUE TO TEMPERATURE.
C   DISTS- THE PERCENTAGE OF EGGS HATCHED.
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      XBAR=K+IGEN(K,1,IN)-1
      XSD=SDEV(K,1)
      DISTS=0.
C  SRVIVE-NO OF FERTILE EGGS REMAINING IN THE POPULATION AFTER ALL
C  MORTALITYS.
C  AP-THE PERCENTAGE OF EGGS NOT HATCHED.
      SRVIVE=POP(K-1)*     EGGFRT(IN)
      AP=1.
C  BEGINNING OF EGG LOOP.
      DO 100 I=K,ILAST
      IF(SRVIVE.LT.1.)GO TO 1100
      C=PREDOR(I,1)*(1.-POS(I,2,IN))
C  TT=THE PROBABILITY THAT EGGS WILL SURVIVE NATURAL MORTALITIES AND
C  PREDATION. TP=THE NO. OF EGGS PARASITISED-ASSUMES IF OVICIDE APPLIED
C  THAT IT WOULD ALSO KILL PARASITE EGG.
C  TPP= THE NO. OF EGGS STERILIZED BY OVICIDE
C  PARASITISED EGGS ARE ASSUMED TO REMAIN IN FIELD 10 DAYS
C  INFERTILE EGGS ARE ASSUMED TO REMAIN IN FIELD FOR 3 - 4 DAYS
C  TINF-TOTAL INFERTILE EGGS IN POPULATION.
   10 TT=(1.-C      )*(1.-DEATH(1,IN))
      POP(I)=POP(I-1)*TT
      IF(KODE(5).NE.4)GO TO 1120
      PTEMP=ABS(72.-TEMAVG(I))
      IF(PTEMP.GT.22.)PTEMP=22
      IF(PTEMP.LT.8.)PTEMP=8
      PTEMP=1.56-.07*PTEMP
      B=-.693/(15000.*SAREA(I))
      B=(1.-EXP(PARSIT(I,1)*B))*PTEMP*(1.-POS(I,1,IN))
      TP=(POP(I)-APARA)*B*(1.-POS(I,7,IN))
      CALL TRKGRM
      GO TO 1121
 1120 CONTINUE
      B=PARSIT(I,1)*(1.-POS(I,1,IN))
      TP=(POP(I)-APARA)*B*(1.-POS(I,7,IN))
      CALL TRKGRM
 1121 CONTINUE
      SRVIVE=SRVIVE*TT*(1.-B      )*(1.-POS(I,7,IN))
      APARA=(APARA*TT)+TP
      TPP=POP(I)*POS(I,7,IN)
      APOSON=(APOSON*TT)+TPP
      TINF=(POP(I)-APARA)*(1.-EGGFRT(IN))+APOSON
C  TOTAL-(I,8,IN)TOTAL NUMBER OF EGGS IN POPULATION ON DAYI.
      TOTAL(I,8,IN)=TOTAL(I,8,IN)+TINF
      IF(AP.LT..0001) GO TO 1110
      X=I
C  ZZ-NO OF EGGS THAT HATCHED ON DAY OF SIMULATION.
      ZZ=SRVIVE*DISTR(DISTS)/AP
      GO TO 1111
 1110 ZZ=SRVIVE
 1111 CONTINUE
      AP =1.-DISTS
      POP(I)=POP(I)-ZZ
C  SLPOP-NO. OF 1 DAY OLD SMALL LARVAE.
      SLPOP(I+1)=SLPOP(I+1)+ZZ
      SRVIVE=SRVIVE-ZZ
C  TOTAL-(I,1,IN)TOTAL NO. OF EGGS IN POPULATION ON DAY I. PARENTHIS
C  INCLUDING INFERTILE AND PARISITIZED EGGS.
      TOTAL(I,1,IN)=TOTAL(I,1,IN)+POP(I)-APARA+TP
  100 CONTINUE
 1100 CONTINUE
C  CHECK TO SEE IF LARVAE IS DEVELOPING ON EARS.
      IF(KODE(11).EQ.1.AND. K.GE.IFRUIT) FOODFK=.65
C SMALL LARVAE ARE EXPOSED TO PARASITES AND PREDATORS FOR ONLY
C 2DAYS WHEN SILKS ARE AVAILABLE FOR SITES
      IF (KODE(11).EQ.1.AND. K.GE.IFRUIT) NN=1
C  PP-TEMPORARY STORAGE OF SMALL LAEVAE 0 TO 1 DAY OLD ON DAY K.
C  LX-CALCULATION OF APPROX. DAYS REQUIRED FOR DEVELOPMENT OF SMALL
C  LARVAE.
      PP=SLPOP(K)
      LX=IGEN(K,2,IN)*FOODFK+.5
      L=K
      IF(SLPOP(K).LT.1.)GO TO 1201
C  XBAR- MEANS DAY NUMBER WHEN SMALL LARVAE BECOMES LARGE LARVAE.
C  XSD-SDEV(K,2)STANDARD DEVIATION FOR SMALL LARVAE DEVELCPMENT.
C  DISTS-PERCENTAGE OF SMALL LARVAE THAT HAVE DEVELOPED INTO LARGE
C  LARVAE.
      XBAR=K+LX-1
      XSD=SDEV(K,2)
      DISTS=0.
      SRVIVE=SLPOP(K)
C  SRVIVE-TEMPORARY STORAGE OF SMALL LARVAE SURVIVING.
      AP=1.
C  AP-PERCENTAGE OF SMALL LARVAE THAT HAVE NOT DEVELOPED IN TO LARGE
C  LARVAE.
      N=0
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C   N-AGE OF SMALL LARVAE.
        XPOP=0.
C   XPOP-TOTAL NO. OF SMALL LARVAE CANNABILIZED BY LARGER LARVAE.
        CANLAR=0.
C   CANLAR-NO. OF SMALL LARVAE CANNABALIZED BY OTHER LARVAE OF THE SAME
C   SIZE.
C   START OF SMALL LARVAE LOOP.
        DO 101 I=K,ILAST
        IF(SRVIVE.LT.1.)GO TO 1200
        N=N+1
C   CHECK TO SEE IF SMALL LARVAE ARE ON CORN SILKS.
        IF(NN.EQ.1.AND.N.GT.2) GO TO 14
        D      =PARSIT(I,2)*(1.-POS(I,1,IN))
C   EQUATION WHICH REDUCES PREDATION PERCENT LEVEL DUE TO AGE OF SMALL
C   LARVAE.
        E      =(EXP(-.42*N)/.657)*PREDOR(I,2)*(1.-POS(I,2,IN))
        GO TO 13
   14   D=0.
        E=0.
   13   T=(1.-D     )*(1.-E     )*(1.-DEATH(2,IN))*(1.-POS(I,3,IN))
        SRVIVE=SRVIVE*T
        KK=I
C   JJ-CODE TO OPERATE CANNIBALISM SUBROUTINE.
        JJ=365
C   CANNIBAL-SUBROUTINE THAT CALCULATES CANNIBALISM FOR ZEA LARVAE.
        CALL CANBAL
 1301   X=I
        IF(AP.LT..0001) GO TO 1210
C   ZZ- NUMBER OF SMALL LARVAE THAT HAVE DEVELOPED INTO LARGE LARVAE ON
C   DAY OF SIMULATION.
        ZZ=SRVIVE*DISTR(DISTS)/AP
        GO TO 1211
 1210   ZZ=SRVIVE
 1211   CONTINUE
        AP =1.-DISTS
C   LLPOP-NO OF LARGE LARVAE 0-1 DAY OLD.
        LLPOP(I+1)=LLPOP(I+1)+ZZ
        SRVIVE=SRVIVE-ZZ

C   TOTAL(I,2,IN) TOTAL NUMBER OF SMALL LARVAE IN THE POPULATION ON
C   DAY I.
        TOTAL (I,2,IN)=TOTAL(I,2,IN)+SRVIVE
  101   CONTINUE
 1200   CONTINUE
 1201   CONTINUE
C   LLPOP-LARGE LARVAE POPULATION (0-1 DAY OF AGE).
        SRVIVE=LLPOP(K)
        L=K-LX+1
        IF(L.LT.IFIRST) L=K
C   L ESTIMATES DAY WHEN EGGS WERE LAID ON FRESH SILKS FOR CANABOLISM
C   OF LARGE LARVA.
        JJ=0
        CALL CANBAL
        WRITE(6,600)L,KK,R,PRBLAR,PRBNEW
  600   FORMAT(2I7,F10.0,2F7.3)
        IF(LLPOP(K).LT. 1)GO TO 1300
C   IGEN-(K,3,IN) DEVELOPMENT TIME FOR LARGE LARVAE.
C   LX-DEVELOPMENT TIME FOR LARGE LARVAE ADJUSTED FOR NUTRITION.
C   XBAR-DAY NO. WHEN THE MEAN NUMBER OF LARGE LARVAE WILL PUPATE.
C   XSD-STANDARD DEVIATION FOR PUPATION.
C   DISTS-PERCENT OF LARGE LARVAE THAT HAVE PUPATED.
C   AP- PERCENT OF LARGE LARVAE THAT HAVE NOT PUPATED.
        LX=IGEN(K,3,IN)*FOCDFK+.5
        XBAR=K+LX-1
        XSD=SDEV(K,3)
        DISTS=0.
        AP=1.
C   START OF LARGE LARVAE LOOP.
        DO 102 I=K,ILAST
        IF(SRVIVE.LT.1.)GO TO 1300
        T=(1.-DEATH(3,IN))*(1.-POS(I,4,IN))
C   T-MORTALITY DUE TO INSECTICIDE AND NATURAL MORTALITY.
C   SRVIVE-NO. OF LARGE LARVAE SURVIVING.
        SRVIVE=SRVIVE*T
        X=I
        IF(AP.LT..0001) GO TO 1310
        ZZ=SRVIVE*DISTR(DISTS)/AP
C   ZZ-NO OF LARGE LARVAE THAT HAVE PUPATED ON DAY OF SIMULATION.
        GO TO 1311
 1310   ZZ=SRVIVE
 1311   CONTINUE
        AP =1.-DISTS
C   PPOP-NO.OF PUPAE.
        PPOP(I+1)=PPOP(I+1)+ZZ
        SRVIVE=SRVIVE-ZZ
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      C   TOTAL-(I,3,IN) TCTAL NO. OF LARGE LARVAE IN THE POPULATION, ALL AGES
      C   ON CAY OF SIMULATION.
          TOTAL(I,3,IN)=TOTAL(I,3,IN)+SRVIVE
  102 CONTINUE
      C   SRVIVE-NO. OF PUPAE (0-1 DAY OLD)
 1300 SRVIVE=PPOP(K)
          IF(PPOP(K).LT.1)GO TO 1400
      C   IXBAR-XBAR- DAY NO. WHEN THE MEAN NUMBER OF PUPAE BECOME ADULTS.
      C   XSD-STANDARD DEVIATION OF EMERGING ADULTS.
      C   DISTS-PERCENT OF PUPAE THAT HAVE EMERGED.
      C   AP- PERCENT OF PUPAE THAT HAVE NOT EMERGED.
          IXBAR=K+IGEN(K,4,IN)-1
          XBAR=IXBAR
          XSD=SDEV(K,4)
          DISTS=0.
          AP=1.
      C   START OF PUPAE LOOP.
          DO 103 I=K,ILAST
          IF(SRVIVE.LT.1.)GO TO 1400
      C   SRVIVE-NO. OF PUPAE SURVIVING MORTALITYS.(INSECTICIDE + NATURAL)
          SRVIVE=SRVIVE*(1.-DEATH(4,IN))*(1.-POS(I,5,IN))
          X=I
          IF(AP.LT..0001) GO TO 1410
      C   ZZ- NO. OF PUPAE THAT HAVE EMERGED ON DAY OF SIMULATION.
          ZZ=SRVIVE*DISTR(DISTS)/AP
          GO TO 1411
 1410 ZZ=SRVIVE
 1411 CONTINUE
          AP =1.-DISTS
          SRVIVE=SRVIVE-ZZ
      C   POAPOP-NO. OF PRE-OVIPOSITIONING ADULTS.(0-1 DAY OF AGE).
          POAPOP(I+1)=POAPOP(I+1)+ZZ
          TOTAL(I,4,IN)=TOTAL(I,4,IN)+SRVIVE
      C   TOTAL-(I,4,IN)TOTAL NO. OF PRE OVIPOSITIONING ADULTS ALL AGES IN
      C   POPULATION.
  103 CONTINUE
 1400 CONTINUE
      C   JJ-DAY NO. WHEN THE MEAN NUMBER OF PRE-OVIPOSITIONED MOTHS BECOME
      C   OVIPOSITIONED ADULTS.
          JJ=K+IGEN(K,5,IN)
          IF(POAPOP(K).LT.1.)GO TO 202
          IF(JJ.GT.ILAST) JJ=ILAST
      C   SRVIVE-NO.OF PRE-OVIPOSITIONING ADULTS(0-1 DAY OF AGE).
      C   L- AGE COUNTER OF ADULTS.
      C   DEATHY-MORTALITY OF ADULTS FROM PREVIOUS DAY.
          SRVIVE=POAPOP(K)
          L=1
          DEATHY=0.0
      C   ADTS- NO. OF ADULTS MIGRATING ON DAY OF SIMULATION PLUS THE NUMBER
      C   OF ADULTS THAT HAVE MIGRATED AND SURVIVED FROM THE PREVIOUS DAY FOR
      C   THIS PARTICULAR CHORT.
          ADTS(K -1,IN)=0.0
      C   START OF PRE-OVAPOSITIONING LOOP.
          DO 104 I=K,JJ
      C   ADULT-SUBROUTINE USED FOR CALCULATIONS FOR NATURAL MORTALITY DUE TO
      C   TEMPERATURE.
      C   SURV-PERCENT SURVIVED TO THE NEXT DAY.
          CALL ADULT
          SRVIVE=SRVIVE*SURV     *(1.-DEATH(5,IN))*(1.-POS(I,6,IN))
          IF(KODE(6).EQ.0)GO TO 1041
          IF(KODE(11).EQ.3) GO TO 1041
      C THIS REDUCES THE NUMBER OF ADULTS IN CROP EACH DAY BY THE PERCENT
      C   PROBABLITY THAT THEY HAVE MIGRATED AWAY.
          ADTS(I,IN)=ADTS(I-1,IN)*SURV     *(1. -DEATH(5,IN))+SRVIVE    *PRMG
         1RT(I,IN)
      C   ADTSMG-TOTAL NO. OF ADULTS THAT HAVE MIGRATED FROM A PARTICULAR CROP
      C   ON DAY OF SIMULATICN.(ALL AGES)
          ADTSMG(I,KCROP,IN)=ADTSMG(I,KCROP,IN)+ADTS(I,IN)
          SRVIVE=SRVIVE*(1-PRMGRT(I,IN))
 1041 CONTINUE
      C   TOTAL-(I,5,IN) TOTAL NO OF PRE-OVIPOSITIONED ADULTS ON DAY OF
      C   SIMULATION. (ALL AGES)
          TOTAL(I,5,IN)=TOTAL(I,5,IN)+SRVIVE
  104 L=L+1
          LL=L-1
      C   T-TEMPERATURE SUM OF RUNNING AVERAGE.
      C   AGE-LENGTH OF TIME MOTH IS BEING OVIPOSITIONED.
          T=0.
          AGE=0.
          KK=JJ+1
          IF(KK.GT.ILAST)GO TO 202
      C   JJ-MEAN LENGTH OF CVIPOSITIONING PERIOD.
          JJ=JJ+IGEN(K,6,IN)
          IF(JJ.GT.ILAST)JJ=ILAST
      C   START OF OVAPOSITICNED LOOP.
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      DO 105 I=KK,JJ
      AGE=AGE+1.0
      T=T+TEMAVG(I)
C  TRUN-RUNNING DAILY AVERAGE TEMPERATURE.
      TRUN=T/AGE
      IF(TRUN.LT.55.)GO TO 1052
C  IPEAK-NO. OF DAYS IT TAKES AN OVIPOSITIONING MOTH TO REACH MAX.EGG
C  PRODUCTION.
      IPEAK=(3029282.9*( TRUN )**(-3.111))+.4
      IF(L.LT.IPEAK)GO TO 1053
C  ITOP-NO. OF DAYS MOTH WILL BE AT MAX PRODUCTION OF EGGS.
      ITOP=(239741.3*(TRUN )**(-2.615402))+.5
      IPEAK=IPEAK+ITOP
      IF(L.LE.IPEAK)GO TO 1054
C  IEND-NO. OF DAYS AN OVIPOSITIONING MOTH WILL PRODUCE EGGS.
      IEND=(91C998.7*(TRUN )**(-2.53))+.5
      IF(L.GE.IEND)GO TO 1052
      XS=L-IPEAK
      XB=IEND-IPEAK
C  ELPDTA-PROBABILITY THAT A MOTH IS AT MAX. EGG PRODUCTION.
      ELPDTA=1.-XS/XB
      GO TO 1060
 1052 ELPDTA=0.0
      GO TO 1060
 1053 XS=L-LL
      XF=IPEAK-LL
      ELPDTA=XS/XF
      GO TO 1060
 1054 ELPDTA=1.0
      GO TO 1060
C  REDUCES PROBABILITY OF MAX PRODUCTION OF EGGS EFFECTED BY MOONLIGHT.
 1060 ELPDTA=ELPDTA
      CALL ADULT
      SRVIVE=SRVIVE*SURV    *(1.-DEATH(5,IN))*(1.-POS(1,5,IN))
      IF(KODE(6).EQ.0) GO TO 1051
      IF(KCROP.GT.2) GO TO 1051
      ADTS(I,IN)=ADTS(I-1,IN)*SURV    *(1.-DEATH(5,IN))+SRVIVE   *PRMGRT(
     2I,IN)
      ADTSMG(I,KCROP,IN)=ADTSMG(I,KCROP,IN)+ADTS(I,IN)
C  TOTMGS-TOTAL NO. OF OVIPOSITIONING ADULTS THAT HAVE MIGRATED AND
C  SURVIVED.
      TOTMGS(I,IN)=TOTMGS(I,IN)+ADTS(I,IN)*ELPDTA
      SRVIVE=SRVIVE*(1.-PRMGRT(I,IN))
 1051 CONTINUE
C  EQELAD-EQUIVILANT EGG LAYING ADULTS (TOTAL NO. OF OVIPOSITIONING
C  ADULTS.
C  REMAINING IN CROP,ADJUSTED FOR EGG LAY POTENTIAL AND MOONLIGHT)
      EQELAD(I,IN)=EQELAD(I,IN)+SRVIVE*ELPDTA
C  TOTAL-(I,6,IN)TOTAL NO. OF OVIPOSITIONING ADULTS IN POPULATION -
C  ALL AGES ON DAY OF SIMULATION.
      TOTAL(I,6,IN)=TOTAL(I,6,IN)+SRVIVE
  105 L=L+1
  202 IF(KODE(7).NE.K) GO TO 200
  605 FORMAT(' ',25X,'BOLLWORM HELIOTHIS ZEA')
  606 FORMAT(' ',25X'TOBACCO BUDWORM HELIOTHIS VIRESCENS')
  200 CONTINUE
C  PRINTOUT OF ALL POPULATION  TOTALS.
      DO 1070 IN =IH,IV
      WRITE(6,608)
  608 FORMAT('1',25X,'PRINTOUT OF TOTAL POPULATION OF VARIOUS LIFE STAGE
     *S ON ANY DAY')
      IF(IN.EQ.2) GO TO 1071
      WRITE(6,605)
      GO TO 1072
 1071 WRITE(6,606)
 1072 WRITE(6,610)
  610 FORMAT('  DAY NO.  EGGS 1ST-3RD 4TH-5TH   PUPAE P ADULT O ADULT
     2INPUT  EQELAD MIGRATS IN EGGS PAR EGG  TOTMGS   TRICHS')
      IF(KCROP.GT.2)KCROP=2
      FACTBB=KRUN-(KCROP*10.)-1.
      FACTAA=FACTBB/(FACTBB+1.)
      FACTBB=FACTBB+1.
      DO 107 K=IFIRST,ILAST
      IF(KRUN.LT.11) GO TO 1076
      ADTSMG(K,KCROP,IN)=ADTSMG(K,KCROP,IN)*FACTAA+TOTMGS(K,IN)/FACTBB
      GO TO 1077
 1076 ADTSMG(K,KCROP,IN)=TOTMGS(K,IN)
 1077 CONTINUE
      IF(KODE(16).GE.200) GO TO 1073
      IF(S(IN).LT.TOTAL(K,1,IN))S(IN)=TOTAL(K,1,IN)
      IF(S(IN+2).LT.TOTAL(K,7,IN))S(IN+2)=TOTAL(K,7,IN)
      IF(S(IN+2).LT.EQELAD(K,IN)) S(IN+2)=EQELAD(K,IN)
      IF(S(IN+2).LT.ADTSMG(K,KCROP,IN)) S(IN+2)=ADTSMG(K,KCROP,IN)
 1073 CONTINUE
      TOT9          =( TOTAL(K,9,IN)/(TOTAL(K,1,IN)+1.))*100.
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      WRITE(6,602)K,(TOTAL(K,J,IN),J=1,7),EQELAD(K,IN),ADTSMG(K,KCROP,IN
     1),TOTAL(K,8,IN),TOT9,TOTMGS(K,IN),PARSIT(K,1)
  602 FORMAT(' ',I6,12F8.0,F8.1,F8.0)
      TOTAL(K,8,IN)=ADTSMG(K,KCROP,IN)
  107 CONTINUE
      IF(IN.EQ.2) GO TO 1070
      IPX=13
C  SMOTH-SUBROUTINE FOR APPLYING 3 DAY MOVING AVERAGE TO ADULTS THAT
C  HAVE MIGRATED.
      ILASTC=ILAST
      CALL SMOOTH
 1070 CONTINUE
      IF (KODE(16).GE.200)GO TO 1075
C  SETS FLAGS FOR PLOT OF DATA.
      IF(KODE(16).GE.100) NPLOT=KODE(16)-100
      IF(KODE(16).LT.100) NPLOT =KODE(16)
      DO 1074 I=1,NPLOT
      READ(5,510)((IGKODE(J,K),J=1,12),K=1,3)
  510 FORMAT(36I2)
      K1=11
      K2=12
      DO 1082 K=1,3
      DO 1081 J=K1,K2
      IF(IGKODE(J,K).EQ.0) GO TO 1081
      IF(IDX.EQ.0) GO TO 552
      DO 1083 KJ=IFIRST,ILAST
C  DATX-ARRAY FOR STORING FIELD DATA OF INSECT POPULATION WANTED ON
C  PLOT TO COMPARE TO SIMULATED WEATHER.
 1083 DATX(KJ)=0.
      IDX=1
552   READ(18,551,END=1081)ID,X
  551 FORMAT(6X,I6,F6.0)
      IF(ID.EQ.0) GO TO 1081
      DATX(ID)=X
      GO TO 552
 1081 CONTINUE
 1082 CONTINUE
C  GRAPH-SUBROUTINE FOR PLOTTING VARIOUS STAGES FOR INSECT POPULATION.
      CALL GRAPH
 1074 CONTINUE
 1075 CONTINUE
C  CHECK TO SEE IF THIS IS LAST SIMULATION WITH INSECT POPULATION.
      READ(5,550,END=1085) KRUN
  550 FORMAT(I3)
      IF(KRUN.EQ.0) STOP
      DO 1080 I=1,4
 1080 S(I)=0.0
      GO TO 34
 1085 STOP
      END
```

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      SUBROUTINE ADULT
C  THIS SUBROUTINE CALCULATES MORTALITY RATES FOR ADULTS AS DESCRIBED
C  IN TEXT.
      COMMON KODE(20),DUM60(11788),TEMAVG(370),DUM61(16282),L,I,DEATHY,
     A SURV,SADULT(2286)
      IF(TEMAVG(I).LT.68.) GO TO 103
      FACTK=-1.2919+.02724*TEMAVG(I)
      GO TO 102
  103 FACTK=.56
C FACTK=1.22-92, 1.00-86, .806-77, .560-68
  102 DEATHX=1.7724*EXP(-11.4457/(FACTK*L))
      IF(L.EQ.1) GO TO 101
      DEATHY=1.7724*EXP(-11.4457/(FACTK*(L-1)))
  101 SURV    =(1.-DEATHX)/(1.-DEATHY)
      RETURN
      END
```

```
      SUBROUTINE CANBAL
C  THIS SUBROUTINE CALCULATES THE PROBABILITY OF CANNIBALISM OF H. ZEA
C  LARVAE.
      COMMON DUM48(3281),EARS(370),DUM49(10747),TOTAL(370,9,2),DUM50(740
     A2),KK,DUMB(744),KCROP,DUM51,SITES(369),S,DF,DUM52(740),CANLAR,JJ,I
     B,NN,XPOP,N,PP,DUM54(2),POP,SCANB(425),PRBLAR,PRBNEW
C NN EQUAL 1 WHEN CROP IS CORN AND SILKS ARE PRESENT
      S=SITES(KK)
      IF(NN.EQ.1)S=EARS(KK   )-EARS(KK-15)+1.
      IF(JJ.EQ.0)GO TO 200
C ESTIMATION OF PROBABILITY OF A LARGER(4-5 INSTAR) LARVAE BEING PRESENT
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C ON A FEEDING SITE ON DAY I
      PRBLAR=TCTAL(I,3,1)/S
      IF(PRBLAR.GT.1.)PRBLAR=1.
      ATE=.05+.05*N
      ATEUP=PRBLAR*POP*ATE
      POP=POP-ATEUP
      XPOP=XPOP+ATEUP
      IF (I.LT.JJ) RETURN
  200 IF(POP.LT.1.)GO TO 1
      P=POP
      XBAR=POP/S
      DF=.36
      PRBNEW=1.-(DF/(DF+XBAR))**DF
      CANLAR=POP-S*PRBNEW
      POP=POP-CANLAR
    4 CONTINUE
C ASSUMES THAT ONLY 1 LARGE LARVAE WILL SURVIVE PER SITE
      PRBNEW=CANLAR/P
      GO TO 5
    1 PRBNEW=0.
    5 IF(PP.LT.1.) GO TO 6
      PRBLAR=XPOP/PP
      GO TO 2
    6 PRBLAR=0.
    2 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE CROP
C   THIS SUBROUTINE CALCULATES THE VARIOUS PHENOLOGICAL STAGES. THE
C   RELATIVE SEARCH AREA,AND NUMBER OF SITES (E.G.,EARS)FOR CORN. DEGREE
C   -DAYS AS DESCRIBED ARE USED TO MAKE THESE CALCULATIONS.
      COMMON KODE(20),DUM15(1851),ED(370),EDCORN(300),SQUARE(370),BOLLS
     A(370),EARS(370),HEADS(370),DUM16(374),EGLYTM(370),IFIRST,ILASTC,IH
     B,IV,DUM17(370),SAREA(370),DUMA(370),ILAST,KRUN,SEXRTO(370,2),
     CDUM18(2),PCTCRP(5),IGENZ(370,7),DUMI(2590),TEMAVG(370),DUM19(15540
     D),PRMGRT(370,2),IA,IM,DUM20(4),EGLYPR(370,2),PLANTS,KCROP,IF,SITES
     E(370),DF,EGLYCR(370,2),DUMMY(7),IN,K,DUMMY2,X,DUMMY3(423),IE
      DATA A20,A21,A22/-40.6667,83.3333,-41.6667/
      DATA A30,A31,A32,A33/.2,1.522,-2.8977,1.4394/
      DATA AM30,AM31,AM32,AM33/.2,1.09554,-1.13822,.19044/
      DATA AM20,AM21,AM22/-17.5,37.0,-18.5/
      DATA A40,A41,A42/4.34331,-5.41664,1.6927/
      KCROP=KODE(11)
      IF(KCROP.EQ.1) DD=1240
      IF(KCROP.EQ.2) DD=1390.
      DDA=205.
      IF(KCROP.NE.3)GO TO 66
      DDA=681.
      DDB=570.
      DDM=1130.
C YIELD=1.5
C ASSUME 44% LOSS OF SQUARES AND 10% LOSS OF BOLLS
      YIELD=1.5
      YIELDS=YIELD*7000000.
      YIELDB=YIELD*7600000.
      YIELDT=400000*YIELD*.8
   66 CONTINUE
      IF(KRUN.EQ.0) GO TO 8
      IF(KODE(14).EQ.0) RETURN
    8 READ(5,500)IP,IE,IF,IM,PLANTS,NATRAC,(PCTCRP(I),I=1,5)
  500 FORMAT(4I6,F6.0,I6,5F3.2)
C IP=PLANTING DATE- IE=EMERGENCE DATE- IE=IP+8  FOR SORGHUM-NATRAC(IA)
C  FOR SORGHUM=191 DEGREE DAYS AFTER IE. MAXIMIN
C  ATTRACTION FOR SORGHUM BETWEEN BOOT AND MILK STAGE-1735 DEGREE DAYS
C  AFTER IE OR 1594 DEGREE DAYS AFTER NATRAC
C ASSUME 105,000 BOLLS/ACRE=1 BALE/ACRE
C DEGREE DAYS USED FOR HELIOTHIS ZEA IS ALSO USED FOR COTTON.
C IE TO IS(1ST SQ)=681.IS TO IB (1ST BOLL) 570.
C IB TO IM(1ST OPEN BOLL)=1130.
C NATRAC=DAY OF FIRST SQUARE
      IF(KCROP.EQ.3.AND.IP.EQ.0)IP=90
      IF(IP.EQ.0)IP=75
      IF(IE.EQ.0)IE=IP+8
      IF(NATRAC.NE.0)GO TO 60
      IA=IE+1
      IF(KCROP.EQ.3)GO TO 65
      IF(IF.NE.0) GO TO 63
   61 SUM=EDCORN(IA)-EDCORN(IE)
      IF(SUM.GE.DDA)GO TO 62
      IA=IA+1
      GO TO 61
```

```
   65 SUM=ED(IA)-ED(IE)
      IF(SUM.GE.DDB)GO TO 62
      IA=IA+1
      GO TO 65
63    IA=IF-50
      DDF=DD*.84
67    IF(EDCORN(IF)-EDCORN(IA).GE.DDF)GO TO 62
      IA=IA-1
      GO TO 67
   62 NATRAC=IA
   60 KFF=IFIRST-1
      IA=NATRAC
      SEXRTO (KFF,1)=0.0
      SEXRTO (KFF,2)=0.0
      EGLYTM(KFF)=EGLYTM(IFIRST)
      DO 5 K=KFF,ILAST
C ADJUSTES PROBABLE EGG LAY FOR TEMPERATURE
      X=ABS(75.-EGLYTM(K))
      IF(X.GT.21.) X=21.
      IF(X.LT.3.) X=2.
      P=1.1-.05146*X
    9 DO 5 IN=IH,IV
      IF(K.GE.NATRAC)GO TO 110
      EGLYPR(K,IN)=.1*P
      EGLYCR(K,IN)=.333
      X=0.
      GO TO 111
  110 GO TO (102,105,103,108,5),KCROP
C NATRAC IS DATE CROP BECOMES ATTRACTIVE TO HELIOTHIS
C CORN-NATRAC WHEN 6-12 INCHES TALL-1210 DEGREE DAYS
C FROM NATRAC TO MAXIMUM SILKING-(50-86 DEGREES)
C NATRAC ALSO DATE WHEN SEARCH AREA=1 UNIT
  102 X=(EDCORN(K)-EDCORN(NATRAC))/DD
      IF(X.GT.1.60) GO TO 112
  120 IF(K.GT.ILASTC) GO TO 104
      IF(KODE(1).NE.3) GO TO 104
C REPLACE GO TO 104 WITH GO TO 106 IF TRAP SEX RATIO TO BE USED
      GO TO 104
  105 X=(EDCORN(K)-EDCORN(NATRAC))/DD
      IF(X.GT.1.2)GO TO 112
      IF(K.GT.ILASTC)GO TO 107
      IF(KODE(1).NE.3)GO TO 107
      GO TO 106
  103 X=(ED(K)-ED(NATRAC))/26
      IF(K.GT.ILASTC)GO TO 111
      IF(KODE(1).NE.3.AND.KODE(1).NE.5) GO TO 111
  106 EGLYCR(K,IN)=(SQRT(SEXRTO(K,IN)))/3.
      IF(EGLYCR(K,IN).GT.1)EGLYCR(K,IN)=1.0
      IF(EGLYCR(K,IN).LT..166) EGLYCR(K,IN)=.166
      EGLYPR(K,IN)=EGLYCR(K,IN)*P
      GO TO 111
C-SEXRTO EQUATIONS NEED TO BE PUT HERE OR CAL. OF EGGLAY PROOF-
  104 IF(IH.EQ.1.AND.IN.EQ.2)GO TO 2
      IF(X.GT.1.12) GO TO 2016
      IF(X.GT..86846)GO TO 2015
      SEXRTO(K,IN)=A30+(A31+(A32+A33*X)*X)*X
      GO TO 2019
 2016 SEXRTO(K,IN)=A40+(A41+A42*X)*X
      GO TO 2019
 2015 SEXRTO(K,IN)=A20+(A21+A22*X)*X
 2019 EGLYCR(K,IN)=SQRT(SEXRTO(K,IN))
      IF(EGLYCR(K,IN).LT..166) EGLYCR(K,IN)=.166
      EGLYPR(K,IN)=EGLYCR(K,IN)*P
      GO TO 111
  107 IF(IH.EQ.1.AND.IN.EQ.2)GO TO 2
      IF(X.GT..835)GO TO 2025
      SEXRTO(K,IN)=AM30+(AM31+(AM32+AM33*X)*X)*X
      GO TO 2026
 2025 SEXRTO(K,IN)=AM20+(AM21+AM22*X)*X
C REDUCTION OF EGG LAY DUE TO CROP FACTOR (.5 FOR SORGHUM)
 2026 EGLYCR(K,IN)=SQRT(SEXRTO(K,IN))*.5
      EGLYPR(K,IN)=EGLYCR(K,IN)*P
      GO TO 111
  112 EGLYPR(K,IN)=0.
      EGLYCR(K,IN)=.166
  111 GO TO (10,11,12,13),KCROP
   10 CONTINUE
      IF(IH.EQ.1.AND.IN.EQ.2) GO TO 2
      IF(X.LT..84) GO TO 303
      IF(X.GT.1.16) GO TO 303
      IM=K
      TP=(1.-X)*16.66667
      S=.4*EXP(-(TP*TP)/2.)
      DELTAX=(X-X1)/.06
C ASSUME 1 EAR PER PLANT
```

```
  302 EARS(K)=EARS(K-1)+PLANTS    *S*DELTAX
      GO TO 304
  303 EARS (K)=EARS(K-1)
  304 X1=X
      IF(K.LE.NATRAC)GO TO 300
      IF(X.GT.1)GO TO 301
      SAREA(K)=X*5.+1.
      GO TO 33
  300 SAREA(K)=1.0
      GO TO 33
  301 SAREA(K)=SAREA(K-1)
C ASSUME 6 SITES PER PLANT AT A SEARCH AREA OF 1
   33 SITES(K)=SAREA(K)*PLANTS    +EARS(K)
      IF(KODE(6).EQ.0)GO TO 5
      CALL MIGRAT
      GO TO 5
   11 CONTINUE
      IF(IH.EQ.1.AND.IN.EQ.2) GO TO 2
      IF(X.LT..84) GO TO 404
      IF(X.GT.1.16)GO TO 404
      IM=K
      TP=(1.-X)/.04
      S=.4*EXP(-(TP*TP)/2.)
      DELTAX=(X-X1)/.04
      HEADS(K)=HEADS(K-1)+PLANTS*S*DELTAX
      GO TO 405
  404 HEADS(K)=HEADS(K-1)
  405 X1=X
      IF(K.LE.NATRAC)GO TO 400
      IF(X.GT.1)GO TO 401
      SAREA(K)=X*5.+1
      GO TO 43
  400 SAREA(K)=1.0
      GO TO 43
  401 SAREA(K)=SAREA(K-1)
   43 SITES(K)=SAREA(K)*PLANTS+HEADS(K)
      IF(KODE(6).EQ.0)GO TO 5
      CALL MIGRAT
      GO TO 5
   12 CONTINUE
C  IS=FIRST SQUARE, IB = FIRST BOLL, IE=EMERGENCE DATE, IP=PLANTING DATE
      IM=NATRAC+88
      IF(IH.EQ.1.AND.IN.EQ.2)GO TO 2
       IF(K.LT.NATRAC)GO TO 21
      IF(X.GT.88.)GO TO 22
      IF(K.EQ.KFF)X1=X-1.
      TP=(40.-X)/13.3
      S=.4*EXP(-(TP*TP)/2.)
      DELTAX=(X-X1)/13.3
      SQUARE(K)=S*DELTAX*YIELDS
      GO TO 24
   22 SQUARE(K)=0.0
   24 IF(X.LE.21.)GO TO 23
      TP=(66.-X)/16.
      S=.4*EXP(-(TP*TP)/2.)
      DELTAX=(X-X1)/16.
      BOLLS(K)=S*DELTAX*YIELDB
      GO TO 26
   23 BOLLS(K)=0.0
   26 SAREA(K)=X/20.+1.0
      FRUIT=SQUARE(K)+BOLLS(K)
   27 SITES(K)=SAREA(K)*PLANTS+FRUIT
      X1=X
      IF(K.GT.ILASTC) GO TO 28
      IF(KODE(1).EQ.3.OR.KODE(1).EQ.5) GO TO 5
C REDUCTION OF EGG LAY DUE TO CROP FACTOT(.7 FOR COTTON)
   28 EGLYCR(K,IN)=(FRUIT/YIELDT+.1)*.7
      EGLYPR(K,IN)=EGLYCR(K,IN)*P
      GO TO 5
   21 SQUARE(K)=0.0
      BOLLS(K)=0.0
      SAREA(K)=1.0
      SITES(K)=PLANTS
      X1=X
      GO TO 5
    2 EGLYPR(K,IN)=EGLYPR(K,IN-1)
      EGLYCR(K,IN)=EGLYCR(K,IN-1)
      IF(KODE(6).NE.1)GO TO 5
      CALL MIGRAT
      GO TO 5
  108 EGLYCR(K,IN)=.5
      EGLYPR(K,IN)=.5*P
    5 CONTINUE
   13 RETURN
      END
```

```
      SUBROUTINE EGGINP
C  THIS SUBROUTINE HANDLES THE INPUT OF HELIOTHIS POPULATIONS FOR
C  INITIATING THE MODEL.
      COMMON KODE(20),FACTD,DJM1(4744),IFIRST,ILASTC,IH,IV,DUM2(1110),
     A ILAST,KRUN,SEXRTO(370,2),EGPEMT(2),PCTCRP(5),DUM3(5290),ADTSMG
     B(370,2,2),TOTAL(370,9,2),SUBEGG(9692)
      DIMENSION EQELAD(370,2)
      DIMENSION S(10)
      IEND=370
      IF(KRUN.EQ.0) GO TO 20
      DO 21 I=1,370
      DO 21 J=IH,IV
      EQELAD(I,J)=0.
   21 TOTAL (I,7,J)=0.0
      IF(KODE(6).EQ.2) GO TO 22
20    CONTINUE
      L=KODE(1)
      X=1.
      IF(L.EQ.4)X=.31
      IF(L.EQ.6)X=.31
      GO TO (1,2,3,2,22,30,30),L
C READS IN MOTHES TOTAL NO. BOTH SEXES COMBINED
1     DO 19 J=IFIRST,ILASTC
11    READ(11,502)I,BMALE,BFMALE,CMALE,CFMALE
      IF(I.NE.J) GO TO 11
      TOTAL(I,7,1)=(BMALE+BFMALE)
      TOTAL(I,7,2)=(CMALE+CFMALE)
19    CONTINUE
      GO TO 5
C READS IN 0-1 DAY OLD EGGS/ACRE
2     DO 29 J=IFIRST,ILASTC
12    READ(11,501)I,B,C
  501 FORMAT(9X,I3,2F6.0)
      IF(I.NE.J) GO TO 12
      IF(L.EQ.4)I=I-2
      TOTAL(I,7,1)=(B/EGPEMT(1))*X
      TOTAL(I,7,2)=(C/EGPEMT(2))*X
29    CONTINUE
      GO TO 5
C READS IN MOTHES SEX SEPARATELY
3     DO 39 J=IFIRST,ILASTC
13    READ(11,502)I,BMALE,BFMALE,CMALE,CFMALE
  502 FORMAT(I6,4F6.1)
      IF(I.NE.J) GO TO 13
      TOTAL(I,7,1)=BMALE           *2.
      TOTAL(I,7,2)=CMALE           *2.
      SEXRTO(I,1)=(BMALE+1.0)/(BFMALE+1.)
      SEXRTO(I,2)=(CMALE+1.0)/(CFMALE+1.)
39    CONTINUE
      GO TO 5
30    ILASTC=1
      IFIRST=365
      READ(11,504)B,C,I
  504 FORMAT(18X,2F6.0,6X,I3)
      IF(I.EQ.0)GO TO 5
      IF(L.EQ.6)I=I-2
      TOTAL(I,7,1)=(B*X)/EGPEMT(1)
      TOTAL(I,7,2)=(C*X)/EGPEMT(2)
      IF(IFIRST.GT.I)IFIRST=I
      IL=ILASTC
      IF(ILASTC.LT.I)ILASTC=I
      IF(IFIRST.EQ.ILASTC)GO TO 31
      IDD=ILASTC-IL
      IF(IDD.EQ.1)GO TO 31
      XDL1=TOTAL(ILASTC,7,1)-TOTAL(IL,7,1)
      XDL2=TOTAL(ILASTC,7,2)-TOTAL(IL,7,2)
      XDL1=XDL1/IDD
      XDL2=XDL2/IDD
      IDD=IDD-1
      DO 32 J=1,IDD
      TOTAL(IL+J,7,1)=TOTAL(IL,7,1)+XDL1*J
      TOTAL(IL+J,7,2)=TOTAL(IL,7,2)+XDL2*J
   32 CONTINUE
      GO TO 30
   31 IL=ILASTC
      GO TO 30
   22 DO 24 I=IFIRST,ILAST
      DO 24 IN=IH,IV
      IF(IN.EQ.2) GO TO 27
      DO 28 J=1,2
C  MOTHS EMERGING FROM CORN LAY 3 TIMES AS MANY EGGS AS MOTHS EMERGING
C  FROM SORGHUM.
      XEGG=1.0
      IF(J.EQ.2)XEGG=.333
      TOTAL(I,7,IN)=(ADTSMG(I,J,IN)*PCTCRP(J)/PCTCRP(KODE(11)))*XEGG+TOT
```

```
     2AL(I,7,IN)
  28 CONTINUE
     GO TO 24
27   IF(I.GT.ILASTC) GO TO 24
26   READ(11,503)K,CMALE,CFMALE
 503 FORMAT(I6,12X,2F6.1)
     IF(K.NE.I) GO TO 26
     TOTAL(I,7,IN)=CMALE*2.
  24 CONTINUE
5    CONTINUE
     RETURN
     END
```

```
      SUBROUTINE FLDPOP
C   THIS SUBROUTINE CONVERTS LIGHT TRAP CATCHES TO FIELD POPULATION(MOTHS
C   /ACRE)AS DESCRIBED BY HARTSTACK ET AL (1971) AND HARTSTACK AND
C   HOLLINGSWORTH (1974). THE LIGHT TRAP CATCHES ARE ADJUSTED FOR LOW
C   NIGHT TEMPERATURE ALSO.
      REAL NITMIN
      COMMON KODE(20),FACTD,DUM37(1480),NITMIN(370),DUM38(2524),EGLYTM(3
     A70),IFIRST,ILASTC,IH,IV,ADMOON(370),DUM39(9259),TOTAL(370,9,2),
     BDUM0(9267),IN,DUMP(3),IPX,SFLP(420)
      DATA E,R,FD/.428,98.8,10560./
C TRAP FACTORS FOR 40 WATT BLACKLIGHT TRAP.
      IF (KODE(9).EQ.2)RETURN
      C= 2.*3.1416*R**2.*E*(ALOG((FD+R)/R)-(FD/(FD+R)))
      FACTD=43560./C
C   NEW TRAP DESIGN REDUCES CATCH BY 30 PERCENT IF CENTER CYLINDER IS
C   NOT COUNTED.
      FACTD=FACTD*1.30
C ADJUSTMENT OF TRAP CATCH FOR REDUCTION OF CATCH BY LOW TEMPERATURES.
      IHH=IH
      IF(KODE(1).EQ.7) IHH=2
      DO 100 IDY=IFIRST,ILASTC
      DO 100 IN=IHH,IV
      IF(IDY.GE.154) GO TO 102
      F=136.9-.86667*IDY
      A1=812.4-5.8*IDY
      A2=-23.6753+.20281*IDY
      A3=.252667-.001762*IDY
      TEMP=NITMIN(IDY)
      IF(TEMP.LT.55.) TEMP=55.
      F1=A1+(A2+A3*TEMP)*TEMP
      TRAPIN=FACTD*F/F1
      IF(TRAPIN.LT.FACTD)TRAPIN=FACTD
      GO TO 103
 102  TRAPIN=FACTD
 103  TOTAL(IDY,7,IN)=(TOTAL(IDY,7,IN)*TRAPIN)
 100  CONTINUE
      IF(KODE(8).EQ.0) RETURN
C   IF ACTUAL TRAP CATCHES ARE USED-SUBROUTINE SMOOTH IS CALLED AND
C   CATCHES ARE SMOOTHED BY A DOUBLE 3 DAY MOVING AVERAGE.
      DO 101 I=IHH,IV
      IPX=12
      IN=1
      IF(I.EQ.2)IN=10
      CALL SMOOTH
 101  CONTINUE
      RETURN
      END
```

```
      SUBROUTINE GENLN
C   THIS SUBROUTINE CALCULATES THE NUMBER OF DAYS REQUIRED FOR
C   DEVELOPMENT OF VARIOUS INSECT STAGES ALONG WITH EXPECTED DEVIATIONS
C   FROM MEAN DEVELOPMENT TIME.
      COMMON KODE(20),DUM9,SDEV(370,4),DUM10(370),ED(370),DUM11(2524),
     QIFIRST,DUM12,IH,IV,DUM13(1110),ILAST,KRUN,DUM14(747),IGEN(370,14),
     WTEMAVG(370),SGENLN(18572)
      DIMENSION DEGDAY(6,2),A1(4),A2(4),A3(4)
      DIMENSION JS(4),P(6)
      DIMENSION F(4)
      DATA A1/3*9.35,6.41/,A2/3*-.2235,-.1555/,A3/3*.00135,.00095/
      DATA F/1.0,1.73,1.73,1.41/
      DATA IKODE/0/
    5 IF(KODE(11).EQ.IKODE) RETURN
C   REMOVE NEXT CARD (IF(KRUN.NE.0)RETURN) IF DEVELOPMENT TIME IS TO
C   BE CHANGED.
      IF(KRUN.NE.0) RETURN
      IF(KODE(11).EQ.2.AND.IKODE.EQ.1) RETURN
```

```
      IF(KODE(11).EQ.1.AND.IKODE.EQ.2) RETURN
      IKODE=KODE(11)
      GO TO (1,1,2,1),IKODE
    2 CONTINUE
    1 DEGDAY(1,1)=72.9
      DEGDAY(1,2)=69.
      DEGDAY(2,1)=156.8
      DEGDAY(2,2)=156.8
      DEGDAY(3,1)=216.5
      DEGDAY(3,2)=216.5
      DEGDAY(4,1)=323.1
      DEGDAY(4,2)=323.1
      DEGDAY(5,1)=1000.0
      DEGDAY(5,2)=1000.0
    3 CONTINUE
      IN=7*(IH-1)
      EDICK=ED(IFIRST-1)
      DO 100 I=IFIRST,ILAST
      IGENX=0
      DO 104 L=1,4
      J=L+IN
      SDEV(I,L)=0.0
      DO 101 K=I,365
      X=A1(L)+(A2(L)+A3(L)*TEMAVG(I))*TEMAVG(I)
      SDEV(I,L)=SDEV(I,L)+X*X
      IF(ED(K)-EDICK.LT.DEGDAY(L,IH)) GO TO 101
      IX=K-I+1
      IGENX=IGENX+IX
      IGEN(I,J)=IX
      SDEV(I,L)=SQRT(SDEV(I,L)/IX)*F(L)
      GO TO 104
  101 CONTINUE
  104 CONTINUE
      IGEN(I,IN+5)=(5327.35*TEMAVG(I)**(-1.8238))+.6
      IGEN(I,IN+7)=IGENX+IGEN(I,IN+5)
      IGEN(I,IN+6)=28.25-.24037*TEMAVG(I)
      EDICK=ED(I)
  100 CONTINUE
      IF(IH.EQ.2) RETURN
      IF(IV.EQ.1)RETURN
      DO 202 I=1,4
  202 P(I)=DEGDAY(I,2)/DEGDAY(I,1)
      DO 200 K=IFIRST,ILAST
      DO 203 I=1,4
      J=I+7
      IGEN(K,J)=IGEN(K,I)*P(I)+.5
  203 CONTINUE
      DO 201 I=5,7
      J=I+7
      IGEN(K,J)=IGEN(K,I)
  201 CONTINUE
  200 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE GRAPH
C   THE USE OF THIS SUBROUTINE IS OPTIONAL DEPENDING ON THE NEED FOR A
C   GRAPH OF THE OUTPUT AND OR INPUT OF THE MODEL.
      COMMON KODE(20),DUM66(4001),S(4),DUM67(740),IFIRST,DUM68(1113),
     AILAST,DUM69(6298),EQELAD(370,2),DUM70(1480),TOTAL(370,9,2),DUM71
     B(9272),IGKODE(12,3),DATX(370),SGRAPH(14)
      DIMENSION SCALE(5)
      INTEGER VFA(5)/'(1H ','',I4,','     ','X,I1',')    '/
      INTEGER VFB(5)/'(1H+','',4X,','     ','X,I1',')    '/
      INTEGER DIGIT(127),DIGIT1(70),DIGIT2(57)
      EQUIVALENCE(DIGIT(1),DIGIT1(1)),(DIGIT(71),DIGIT2(1))
      DATA    DIGIT1    /'1','2','3','4','5','6','7','8','9','10','11','
     X12','13','14','15','16','17','18','19','20','21','22','23','24','2
     X5','26','27','28','29','30','31','32','33','34','35','36','37','38
     X','39','40','41','42','43','44','45','46','47','48','49','50','51'
     X,'52','53','54','55','56','57','58','59','60','61','62','63','64',
     X'65','66','67','68','69','70'/
      DATA    DIGIT2    /'71','72','73','74','75','76','77','78','79','8
     X0','81','82','83','84','85','86','87','88','89','90','91','92','93
     X','94','95','96','97','98','99','100','101','102','103','104','105
     X','106','107','108','109','110','111','112','113','114','115','116
     X','117','118','119','120','121','122','123','124','125','126','127
     X'/
      DIMENSION INSECT(3),ISTAGE(10)
      DATA INSECT/'-ZEA','-VIR','-Z+V'/
      DATA ISTAGE/'EGGS','SLAR','LLAR','PUPA', 'POAD','OPAD','INPT','IN
     2MG','PAEG','EQOA'/
      DIMENSION SS(2)
```

```
      SXZ=0.
      SXV=0.
      SXZV=0.
      N=1
      WRITE(1,611)
  611 FORMAT('1')
      NSCALE=0
      ISTG=1
      KSTG=4
   24 DO 2020 IS=ISTG,KSTG
      DO 2020 IN=1,3
      IF(IGKODE(IS,IN).EQ.0)GO TO 2020
      IF(IN.EQ.1)SXZ=1
      IF(IN.EQ.2)SXV=1
      IF(IN.EQ.3)SXZV=1
      WRITE(1,610)N,ISTAGE(IS),INSECT(IN)
  610 FORMAT(' ',20X,I1,' = ',A4,A4)
      N=N+1
 2020 CONTINUE
      IF(IS.GT.6)GO TO 25
      ISTG=9
      KSTG=9
      GO TO 24
   25 CONTINUE
      NN=N
      IF(N.EQ.1)GO TO 2021
      IF(KODE(16).GE.100)GO TO 2024
      WRITE(1,600)
  600 FORMAT(' LOG SCALE PLOT')
      WRITE(1,604)
  604 FORMAT(' ',3X,'100.0',25X,'1000.0',25X,'10000.0',23X,'100000.0'
     V23X,'1000000.0')
      GO TO 2021
 2024 WRITE(1,603)
  603 FORMAT(' LINEAR SCALE PLOT')
   13 IF(SXZ.EQ.1.AND.SXV.EQ.1.AND.SXZV.NE.1)GO TO 10
      IF(SXZV.EQ.1)GO TO 11
      IF(SXZ.EQ.1)SX1=S(1+NSCALE)
      IF(SXV.EQ.1)SX1=S(2+NSCALE)
      GO TO 12
   10 SX1=S(1+NSCALE)
      IF(S(2+NSCALE).GT.S(1+NSCALE))SX1=S(2+NSCALE)
      GO TO 12
   11 SX1=S(1+NSCALE)+S(2+NSCALE)
   12 SCALE(1)=0.0
      DO 101 I=2,5
  101 SCALE(I)=SCALE(I-1)+SX1/4.
      WRITE(1,606)(SCALE(I),I=1,5)
  606 FORMAT(' ',F6.0,2(F31.0,F32.0))
      IF(NSCALE.EQ.0)SS(1)=SX1/127.
      IF(NSCALE.EQ.2)SS(2)=SX1/127.
      IF(NSCALE.EQ.2)GO TO 2023
 2021 ISTG=5
      KSTG=8
   27 DO 2022 IS=ISTG,KSTG
      DO 2022 IN=1,3
      IF(IGKODE(IS,IN).EQ.0) GO TO 2022
      IF(IN.EQ.1)SXZ=1
      IF(IN.EQ.2)SXV=1
      IF(IN.EQ.3)SXZV=1
      WRITE(1,610)N,ISTAGE(IS),INSECT(IN)
      N=N+1
 2022 CONTINUE
      IF(IS.GT.9)GO TO 26
      ISTG=10
      KSTG=10
      GO TO 27
   26 CONTINUE
      IF(N.EQ.NN)GO TO 2023
      IF(KODE(16).GE.100)GO TO 2025
      WRITE(1,600)
      WRITE(1,605)
  605 FORMAT(' ',5X,'1.0',27X,'10.0',27X,'100.0',25X,'1000.0',25X,
     N'10000.0')
      GO TO 2023
 2025 WRITE(1,603)
      NSCALE=2
      GO TO 13
 2023 IF(KODE(16).LT.100)GO TO 3000
      DO 3001 J=IFIRST,ILAST
      WRITE(1,601)J
  601 FORMAT(' ',I4,' .',30X,'.',31X,'.',30X,'.',31X,'.')
      N=1
      DO 3002 I=1,12
      DO 3002 IN=1,3
```

```
      IF(IGKODE(I,IN).EQ.0)GO TO 3002
      IF(IN.EQ.3)GO TO 3003
      GO TO (4,4,4,4,5,5,5,5,4,6,3004,3005),I
    5 K=TOTAL(J,I,IN)/SS(2)+1.
      GO TO 302
    4 K=TOTAL(J,I,IN)/SS(1)+1.
      GO TO 302
    6 K=EQELAD(J,IN)/SS(2)+1.
      GO TO 302
 3005 K=DATX(J)/SS(2)+1.
      GO TO 302
 3004 K=DATX(J)/SS(1)+1.
      GO TO 302
 3003 GO TO (7,7,7,7,8,8,8,8,7,9,3004,3005),I
    7 K=(TOTAL(J,I,1)+TOTAL(J,I,2))/SS(1) +1.
      GO TO 302
    8 K=(TOTAL(J,I,1)+TOTAL(J,I,2))/SS(2) +1.
      GO TO 302
    9 K=(EQELAD(J,1)+EQELAD(J,2))/SS(2)+1.
  302 IF(K.GT.127) K=127
      VFB(3)=DIGIT(K)
      WRITE(1,VFB)N
      N=N+1
 3002 CONTINUE
 3001 CONTINUE
      GO TO 5000
 3000 DO 4000 J=IFIRST,ILAST
      WRITE(1,601) J
      N=1
      DO 4002 I=1,10
      DO 4002 IN=1,3
      IF(IGKODE(I,IN).EQ.0)GO TO 4002
      IF(IN.EQ.3) GO TO 4003
      GO TO (14,14,14,14,15,15,15,15,14,16 ),I
   14 B=TOTAL(J,I,IN)/100.
      GO TO 207
   15 B=TOTAL(J,I,IN)
      GO TO 207
   16 B=EQELAD(J,IN)
      GO TO 207
 4003 GO TO (17,17,17,17,18,18,18,18,17,19),I
   17 B=(TOTAL(J,I,1)+TOTAL(J,I,2))/100.
      GO TO 207
   18 B=(TOTAL(J,I,1)+TOTAL(J,I,2))
      GO TO 207
   19 B=EQELAD(J,1)+EQELAD(J,2)
  207 IF(B.LT.1.1)GO TO 203
      K=(ALOG10(B)/4.)*127
      IF(K.GT.127)K=127
  205 VFB(3)=DIGIT(K)
      WRITE(1,VFB)N
      GO TO 208
  203 K=1
      GO TO 205
  208 CONTINUE
      N=N+1
      GO TO 4002
 4002 CONTINUE
 4000 CONTINUE
 5000 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE MIGRAT
C     THIS SUBROUTINE CALCULATES THE PROBABILITY OF MOTHS MIGRATING AWAY
C     FROM A PARTICULAR CROP.
      COMMON KODE(20),DUM55(27698),PRMGRT(370,2),DUM56(747),KCROP,DUM57(
     A1119),IN,K,DUM58,X,SMIGRA(421)
      DIMENSION PCTMG(2)
      DATA PCTMG(1)/.6/,PCTMG(2)/.6/
      DATA XM/1.10/,XD/1.45/
      IF(KODE(15).EQ.0) RETURN
      PRMGRT(K,IN)=0.0
      IF(X.LE.XM)RETURN
      IF(X.GE.XD)GO TO 1
      PRMGRT(K,IN)=((X-XM)/(XD-XM))*PCTMG(IN)
      RETURN
    1 PRMGRT (K,IN)=PCTMG(IN)
      RETURN
      END
```

```
      SUBROUTINE MOON
C  FOR EACH SIMULATION DAY THIS SUBROUTINE CALCULATES THE NUMBER OF
C  DAYS FROM FULL MOON, WHICH IS USED TO SELECT THE PROPER MOONLIGHT
C  ADJUSTMENT FACTOR FOR OVIPOSTION.
      COMMON KODE(20),DUM31(4749),ADMOON(370),DUM32(370),TCLOUD(370),
     ZSMOON(24871)
      DIMENSION FM(29)
      DATA FM/1.,1.,.99,.99,.98,.97,.94,.91,.86,.82,.73,.61,.45,.24,.24,
     2.53,.75,.89,.96,10*1./
      A=KODE(3)
      IF(A.GT.15.) A=A-29.5
      A=A-15.
      DO100 I=1,365
      B=I
      J=B-A
      IF(J.LT.30)GOTO 4
      A=A+29.5
      J=1
 4    CONTINUE
      ADMOON(I)=FM(J)+(1.-FM(J))*TCLOUD(I)
 100  CONTINUE
      RETURN
      END


      SUBROUTINE PARINP
C  THIS SUBROUTINE CALCULATES PARASITISM OF EGGS AND LARVAE AS DESCRIBED
C  IN TEXT
      COMMON KODE(20),DUM21(4745),IFIRST,DUM22(373),SAREA(370),DUM23(370
     A),ILAST,KRUN,DUM24(20357),PARSIT(370,2),DUM25(1480),IA,IM,SPAR(229
     30)
      DIMENSION PA(2)
      IF(KRUN.EQ.0) GO TO 10
      DO 11 I=IFIRST,ILAST
      DO 11 J=1,2
   11 PARSIT(I,J)=0.0
   10 L=KODE(5)
C IF KODE 5 = 4 READ PA(1) = 0
      GO TO (1,2,3,1),L
    1 PMIN1=IA
      PMAX1=IA+20
      PMIN2=IA+20
      PMAX2=IM-20
      PDOWN=IM
      PEND=IM+25
      READ(5,500) PA(1),PA(2)
  500 FORMAT(2F6.3)
      DO 4 I=IFIRST,ILAST
      IF(I.LE.PMIN1.OR.I.GE.PEND) GO TO 4
      IF(KODE(11).EQ.3) GO TO 44
      IF(I.GE.PMAX1) GO TO 7
      FX=((I-PMIN1)/(PMAX1-PMIN1))*.5
      GO TO 6
    7 IF(I.GT.PMIN2) GO TO 8
      FX=.5
      GO TO 6
    8 IF(I.GE.PMAX2) GO TO 9
      FX=.5+((I-PMIN2)/(PMAX2-PMIN2))*.5
      GO TO 6
    9 IF(I.GT.PDOWN) GO TO 99
   98 FX=1.0
      GO TO 6
   99 FX=(PEND-I)/(PEND-PDOWN)
      GO TO 6
   44 IF(I.GE.PMAX1) GO TO 45
      FX=(I-PMIN1)/(PMAX1-PMIN1)
      GO TO 6
   45 IF(I.GT.PMAX2) GO TO 46
      GO TO 98
   46 FX=(PEND-I)/(PEND-PMAX2)
    6 PARSIT(I,1)=PA(1)*FX
      PARSIT(I,2)=PA(2)*FX
    4 CONTINUE
      IF(L.EQ.4)GO TO 12
      GO TO 5
    2 READ(13,501,END=5)I,TRICH,OTHERS,OLARPA
  501 FORMAT(I6,3F6.0)
      IF(I.EQ.0) GO TO 5
C  EGG PARASITIZM
      N=45769
      B=-.693/(N*SAREA(I))
      PTRICH=1.-(EXP(TRICH*B))
      N=5000
      B=-.693/(N*SAREA(I))
      POTHRS=1.-(EXP(OTHERS*B))
```

```
      PARSIT(I,1)=1.-((1.-PTRICH)*(1.-POTHRS))
C   1-3 INSTAR LARVAE PARASITIZM
      N=300
      B=-.693/(N*SAREA(I))
      POTHRS=1.-(EXP(OLARPA*B))
      PARSIT(I,2)=POTHRS
      GO TO 2
    3 READ (13,502,END=5)I,X,Y
  502 FORMAT(I6,2F6.3)
      IF(I.EQ.0) GO TO 5
      PARSIT(I,1)=X
      PARSIT(I,2)=Y
      GO TO 3
   12 READ(13,501,END=5)I,TRICH
      IF(I.EQ.0)GO TO 5
      PARSIT(I,1)=TRICH
      GO TO 12
    5 RETURN
      END
```

```
      SUBROUTINE PRDINP
C  THIS SUBROUTINE CALCULATES PREDATION OF EGGS AND LARVAE AS DESCRIBED
C  ,IN TEXT.
      COMMON KODE(20),DUM26(4745),IFIRST,DUM27(373),SAREA(370),DUM28(370
     A),ILAST,KRUN,DUM29(21097),PREDOR(370,2),DUM30(740),IA,IM,SPRD(2290
     B)
      DIMENSION PA(2)
      DIMENSION PDERTE(7),PDLRTE(7),PRED(7)
      DATA PDERTE/1.25,1.5,.25,.5,1.0,.75,1.75/
      DATA PDLRTE/.5,1.0,.25,.75,1.25,1.75,1.50/
C PDLRTE=PREDATOR RATING FOR LARVAE
C PDERTE=PREDATOR RATING FOR EGGS
C 1=SEYMINUS,2=OTHER COCCINELLIDAE,3=OTHERCOLEOPTERA,
C 4= ORIUS,5=GEOCORIS,6=OTHER HEMIPTERA,7=CHRYSOPAIMMATURES
      IF(KRUN.EQ.0) GO TO 10
      DO 11 I=IFIRST,ILAST
      DO 11 J=1,2
   11 PREDOR(I,J)=0.0
   10 L=KODE(12)
      FX=1.0
      GO TO (1,2,3,30),L
    1 PMIN1=IA
      PMAX1=IA+20
      PMIN2=IA+20
      PMAX2=IM-20
      PDOWN=IM
      PEND=IM+25
      READ(5,500) PA(1),PA(2)
  500 FORMAT(3F6.3)
      DO 4 I=IFIRST,ILAST
      IF(I.LE.PMIN1.OR.I.GE.PEND)  GO TO 4
      IF(KODE(11).EQ.3) GO TO 44
      IF(I.GE.PMAX1) GO TO 7
      FX=((I-PMIN1)/(PMAX1-PMIN1))*.5
      GO TO 6
    7 IF(I.GT.PMIN2) GO TO 8
      FX=.5
      GO TO 6
    8 IF(I.GE.PMAX2) GO TO 9
      FX=.5+((I-PMIN2)/(PMAX2-PMIN2))*.5
      GO TO 6
    9 IF(I.GT.PDOWN) GO TO 99
   98 FX=1.0
      GO TO 6
   99 FX=(PEND-I)/(PEND-PDOWN)
      GO TO 6
   44 IF(I.GE.PMAX1) GO TO 45
      FX=(I-PMIN1)/(PMAX1-PMIN1)
      GO TO 6
   45 IF(I.GT.PMAX2) GO TO 46
      GO TO 98
   46 FX=(PEND-I)/(PEND-PMAX2)
    6 PREDOR(I,1)=PA(1)*FX
      PREDOR(I,2)=PA(2)*FX
    4 CONTINUE
      GO TO 5
    2 READ(14,501,END=5)I,(PRED(J),J=1,7),SPID,CHRYSP
  501 FORMAT(9X,I3,6F6.0,6X,2F6.0,6X,F6.0)
      IF(I.EQ.0) GO TO 5
      OTHEGG=0.0
```

```
      OTHLAR=0.0
      DO 20 K=1,7
      OTHEGG=OTHEGG+PRED(K)*PDERTE(K)
      OTHLAR=OTHLAR+PRED(K)*PDLRTE(K)
   20 CONTINUE
C  EGG PREDATION
      N=44827
      B=-.693/(N*SAREA(I))
      PCHRYS=1.-(EXP(CHRYSP*B))
      N=14368
      B=-.693/(N*SAREA(I))
      POTHRS=1.-(EXP(OTHEGG*B))
      PREDOR(I,1)=1.-(1.-PCHRYS)*(1.-POTHRS)
C  1-3 INSTAR LARVAE PREDATION
      N=13051
      B=-.693/(N*SAREA(I))
      PCHRYS=1.-(EXP(CHRYSP*B))
      N=8929
      B=-.693/(N*SAREA(I))
      POTHRS =1.-(EXP(OTHLAR*B))
      PREDOR(I,2)=1.-(1.-PCHRYS)*(1.-POTHRS)
      GO TO 2
    3 READ(14,502,END=5) I,X,Y,Z
  502 FORMAT(I6,3F6.3)
      IF(I.EQ.0) GO TO 5
      PREDOR(I,1)=X
      PREDOR(I,2)=Y
      GO TO 3
   30 IFF=365
      ILL=1
   31 READ(14,503,END=34)SP,ALB,HEMP,CHL,CHA,CALLOP,I
  503 FORMAT(6X,6F5.0,I3)
      IF(I.EQ.0) GO TO 34
      PREDOR(I,1)=ALB*1.5+HEMP*1.0+CHL*1.75+CHA+CALLOP
      PREDOR(I,2)=ALB+HEMP*1.25+CHL*1.5+CHA+CALLOP
      IF(IFF.GT.I)IFF=I
      IL=ILL
      IF(ILL.LT.I)ILL=I
      IF(IFF.EQ.ILL)GO TO 32
      IDD=ILL-IL
      IF(IDD.EQ.1)GO TO 32
      XDL1=PREDOR(ILL,1)-PREDOR(IL,1)
      XDL2=PREDOR(ILL,2)-PREDOR(IL,2)
      XDL1=XDL1/IDD
      XDL2=XDL2/IDD
      IDD=IDD-1
      DO 33 J=1,IDD
      PREDOR(IL+J,1)=PREDOR(IL,1)+XDL1*J
      PREDOR(IL+J,2)=PREDOR(IL,2)+XDL2*J
   33 CONTINUE
      GO TO 31
   32 IL=ILL
      GO TO 31
   34 NE=14368
      NL=8929
      DO 35 J=IFF,ILL
      B=-.693/(NE*SAREA(J))
      PREDOR(J,1)=1.-(EXP(PREDOR(J,1)*B))
      B=-.693/(NL*SAREA(J))
      PREDOR(J,2)=1.-(EXP(PREDOR(J,2)*B))
   35 CONTINUE
    5 RETURN
      END
```

```
      SUBROUTINE SMOOTH
C  THIS SUBROUTINE WHEN CALLED APPLIES A DOUBLE 3-DAY MOVING AVERAGE
C  TO INSECT POPULATION DATA.
      COMMON DUM62(4765),IXF,IXL,DUM63(7411),SM(370,24),DUM64(9267),IN,
     ADUM65(3),IPX,SSMOO(420)
C IXF-FIRST DAY OF SMOOTH IXL-LAST DAY OF SMOOTH IP- STAGE IN- INSECT
      DIMENSION S(5)
      IP=IPX+IN
      DO 100 I=3,5
  100 S(I)=0.0
      IXXF=IXF+2
      S(1)=SM(IXF+1,IP)
      S(2)=SM(IXF,IP)
      DO 101 I=IXXF,IXL
      K=0
      DO 102 J=2,5
      S(5-K)=S(4-K)
```

```
      102 K=K+1
          S( 1)=SM( I ,IP)
          SM(I-2,IP)=(S(5)+2.*S(4)+3.*S(3)+2.*S(2)+S(1))/9.
      101 CONTINUE
          SM(IXL-1,IP)=(S(4)+2.*S(3)+3.*S(2)+2 .*S(1))/8.
          SM(IXL,IP)=(S(3)+2.*S(2)+3.*S(1))/6.
          RETURN
          END
```

```
          SUBROUTINE SPRAY
C READS IN INSECTICIDE MORTALITIES-J-1THRU12
C   THIS SUBROUTINE HANDLES ALL INPUT OF MORTALITIES CAUSED BY
C   INSECTICIDES.
          COMMON KODE(20),DUM33(4745),IFIRST,DUM34,IH,IV,DUM35(1110),ILAST,
         AKRUN,DUM36(15177),POS(370,7,2),SSPRAY(4512)
          DIMENSION P(7,2)
          IF(KODE(4).EQ.2) RETURN
          IF(KODE(4).EQ.0.AND.KRUN.EQ.0)RETURN
          DO 2 J=1,7
          DO 2 I=IFIRST,ILAST
          DO 2 IN=IH,IV
        2 POS(I,J,IN)=0.0
          IF(KODE(4).EQ.0)RETURN
  100     READ(12,500,END=5)I,((P(J,IN),J=1,7),IN=IH,IV)
      500 FORMAT(I6,14F4.3)
          IF(I.EQ.0)RETURN
          DO 101 IN=IH,IV
          DO 101 J=1,7
      101 POS(I,J,IN)=P(J,IN)
          GO TO 100
  5       RETURN
          END
```

```
          SUBROUTINE TEMP
C   ALL OF THE TEMPERATURE AND CLOUD COVER INPUT AND THE CALCULATION OF
C   DAYS ARE HANDLED BY TEMP.
          REAL NITMIN
          COMMON KODE(20),DUM5(1481),NITMIN(370),ED(370),EDCORN(300),DUM6
         A(1854),EGLYTM(370),IFIPST,DUM7(743),TCLOUD(370),ILAST,DUM8(5928),
         8TEMAVG(370),STEMP(18572),IFISTT,ILASTT
          DIMENSION CLOUD(24)
          DIMENSION TMEA(800)
          DIMENSION TM(24)
          KKK=KODE(2)
          KK =KODE(19)
          ED(IFISTT-1)=0.0
          EDCORN(IFISTT-1)=0.0
          ET=54.7
          T1=50.
          T2=86.
          TD=T2-T1
  503     FORMAT(I3,2F3.0)
          DO 304 IDY=IFISTT,ILASTT
          IF(KKK.NE.3) GO TO 200
          IF(IDY.EQ.IFISTT) GO TO 404
          GO TO 410
  800     KRUN=0
  200     READ(15,502,END=402) I,(TM(J),J=1,24)
      502 FORMAT(2X,I3,3X,24F3.0)
          IF(I.NE.IDY) GO TO 200
          M=I
          GO TO 499
  402     CONTINUE
          WRITE(6,1000) IFISTT,M
  1000    FORMAT('1','HOURLY TEMPERATURE INPUT FROM DAYS ',I3,' TO ',I3)
  404     READ(16,503) I,THP,TLP
          IF(I.NE.IDY) GO TO 404
          WRITE(6,2000) IDY,ILASTT
  2000    FORMAT(' ','MAX/MIN TEMPERATURE INPUT FROM DAYS ',I3,' TO ',I3/)
          KKK=3
  410     CONTINUE
          THO=THP
          TLO=TLP
          READ(16,503) I,THP,TLP
          TAO=(THO+TLO)/2.
          TPO=(THO-TLO)/2.
          TAM=(THO+TLP)/2.
          TPM=(THO-TLP)/2.
          TM(1)=TAO+TPO*(-.96593)
          DO 417 J=2,14
```

```
      TM(J)=TAO+TPO*COS(.2618*(14-J))
417   CONTINUE
      DO 419 J=15,24
      TM(J)=TAM+TPM*COS(.2618*(J-14))
419   CONTINUE
499   IF(KK.EQ.0) GO TO 305
201   READ(17,504,END=306) I,(CLOUD(J),J=1,24)
504   FORMAT(2X,I3,3X,24F3.1)
      IF(I.NE.IDY) GO TO 201
      GO TO 305
306   CONTINUE
      KK=0
  305 CONTINUE
  213 ED(IDY)=ED(IDY-1)
      EDCORN(IDY)=EDCORN(IDY-1)
      TEMAVG(IDY)=0.0
      NITMIN(IDY)=0.0
      DO 3 I=1,24
      IF (TM(I).GT.92) GO TO 565
      TEM=(TM(I)-ET)/24.
      IF (TEM.LT.0.) TEM=0.
      GO TO 35
  565 TEMOVR=TM(I)-92.
      TEM=(37.3-TEMOVR)/24.
   35 CONTINUE
      X=TM(I)-TI
      IF(X)39,39,32
   32 IF(X-TD)34,34,33
   33 X=TD-1.423*(X-TD)
   34 EDCORN(IDY)=EDCORN(IDY)+X/24.
   39 CONTINUE
      IF(I.GT.6)GO TO 563
      NITMIN(IDY-1)=NITMIN(IDY-1)+TM(I)/12.
      GO TO 561
  563 IF(I.LT.19)GO TO 561
      NITMIN(IDY)=NITMIN(IDY)+TM(I)/12.
  561 ED(IDY)=ED(IDY)+TEM
  562 TEMAVG(IDY)=TEMAVG(IDY)+TM(I)/24.
    3 CONTINUE
      DAYLN=12.14+1.94*COS(.01721*(IDY-175))
      IEGG=13.5+DAYLN/2.
      EGLYTM(IDY)=(TM(IEGG)+TM(IEGG+1)+TM(IEGG+2))/3.
      IF(KK.EQ.0) GO TO 304
      TCLOUD(IDY)=(CLOUD(IEGG)+CLOUD(IEGG+1)+CLOUD(IEGG+2))/3.
  304 CONTINUE
  202 RETURN
      END
```

```
      SUBROUTINE TRKGRM
C  THIS SUBROUTINE PROVIDES A DYNAMIC POPULATION MODEL
C  FOR TRICHOGRAMMA.
      COMMON KODE(20),DUM40(5119),SAREA(370),DUM41(370),ILAST,DUM42(748)
     A,IGEN(370,7,2),DUM43(2590),TOTAL(370,9,2),POS(370,7,2),PARSIT(370,
     32),PREDOP(370,2),DUM45(743),I,DUM46(1863),IN,DUM47(410),TP,DEATH(5
     C,2),STPK(3)
      DIMENSION FERATE(20)
      DATA TKSURV/1./
      DATA FERATE/.5,.8,.87,.95,.95,.95,.93,.9,.82,.74,.68,.6,.55,.5,.45
     2,.4,.3,.2,.1,0./
      IF(TP.LT.1)RETURN
      TOTAL(I,9,IN)= TOTAL(I,9,IN)+TP
      TS=TP
      K=I+IGEN(I,1,IN)+IGEN(I,2,IN)-1
      IF(K.GT.ILAST)RETURN
      II=I+1
      DO 100 J=II,K
      X=PREDOP(J,1)*(1.-POS(J,2,IN))
      X=(1.-X)*(1.-DEATH(1,IN))*(1.-POS(J,7,IN))
      TS=TS*X
      TOTAL(J,9,IN)=TOTAL(J,9,IN)+TS
      TOTAL(J,1,IN)=TOTAL(J,1,IN)+TS
  100 CONTINUE
      IF(KODE(5).NE.4) RETURN
C ASSUME EGGS ARE HARD TO FIND AS FUNCTION OF SAREA
C ASSUME 2 FEMALES EMERGE FROM EACH EGG.
      TS=TS*2.*SAREA(II)
      K=K+1
      KK=K+10
      IF(KK.GT.ILAST)KK=ILAST
      IAGE=1
```

```
      DO 200 J=K,KK
      TS=TS*TKSURV
      PARSIT(J,1)=TS*FERATE(IAGE)+PARSIT(J,1)
      IAGE=IAGE+1
  200 CONTINUE
      RETURN
      END
```

```
      FUNCTION DISTR(DISTS)
C   THIS SUBROUTINE CALCULATES THE DEVELOPMENT DISTRIBUTIONS OF COHERTS
C   OF EGGS, LARVAE, AND PUPA. A NORMAL DISTRIBUTION IS ASSUMED (STINNER
C   1974). THE ARRAY GAUS IS AN ACCUMULATION OF THE NORMAL DISTRIBUTION
C   PROBABILITIES FOR + OR - 4 STANDARD DEVIATIONS FROM THE MEAN.
      COMMON DUM72(30328),X,DUM73(418),XBAR,XSD,DUM74
      DIMENSION GAUS1(40),GAUS2(40),GAUS(81)
      EQUIVALENCE (GAUS1(1),GAUS(2)),(GAUS2(1),GAUS(42))
      DATA GAUS(1)/.00003/
      DATA GAUS1/.00005,.00007,.0001,.00015,.00020,.0003,.0005,.0007,.00
     110,.0013,.0019,.0026,.0035,.0047,.0062,.0082,.0107,.0139,.0179,.02
     228,.0287,.0359,.0446,.0548,.0668,.0808,.0968,.1151,.1357,.1587,.18
     341,.2119,.2420,.2743,.3085,.3446,.3821,.4207,.4602,.5000/
      DATA GAUS2/.5388,.5793,.6179,.6554,.6915,.7257,.7580,.7881,.8159,.
     28413,.8643,.8849,.9032,.9192,.9332,.9452,.9554,.9641,.9713,.9772,.
     39821,.9861,.9893,.9918,.9938,.9953,.9965,.9974,.9981,.9987,.9990,.
     49993,.9995,.9997,.9998,.99985,.9999,.99993,.99995,.99997/
      Y=(X-XBAR+.5)/XSD
      IF(Y.GT.-4.)GO TO 1
      DISTR=0.
      RETURN
    1 CONTINUE
      IF(Y.LT.4.)GO TO 2
      DISTR=1.-DISTS
      DISTS=1.
      RETURN
    2 CONTINUE
      INDEX=IFIX((Y+4.1)*10.)
      Y=GAUS(INDEX)
      DISTR=Y-DISTS
      DISTS=Y
      RETURN
      END
```

EXAMPLE INPUT

```
   3    1   27    0    1    1 160    1    1 205    1    1    1    1    1 102    1    3
  45   40   40   30 150 900 300   45   40   40   30 150 900 400
  82 146
  59 236
    56      71     140         14000          2  18  18  59    1
   060     010
   150     200
 1  1  1
                  1  1    1
     82     10                                                         ALL  CROPS  LT  1975
     83                                                                ALL  CROPS  LT  1975
     84     02                                                         ALL  CROPS  LT  1975
     85                                                                ALL  CROPS  LT  1975
     86     08      02                                                 ALL  CROPS  LT  1975
     87                                                                ALL  CROPS  LT  1975
     88                                                                ALL  CROPS  LT  1975
     89     02                                                         ALL  CROPS  LT  1975
     90     02      04                                                 ALL  CROPS  LT  1975
     91     12      02                                                 ALL  CROPS  LT  1975
     92     02                                                         ALL  CROPS  LT  1975
     93                                                                ALL  CROPS  LT  1975
     94             01                                                 ALL  CROPS  LT  1975
     95     02                                                         ALL  CROPS  LT  1975
     96     08      06                                                 ALL  CROPS  LT  1975
     97     10      07                                                 ALL  CROPS  LT  1975
     98     81      37                                                 ALL  CROPS  LT  1975
     99     09      10                                                 ALL  CROPS  LT  1975
    100     01      04                                                 ALL  CROPS  LT  1975
    101             02                                                 ALL  CROPS  LT  1975
    102     01                                                         ALL  CROPS  LT  1975
    103                                                                ALL  CROPS  LT  1975
```

104	78	24	ALL CROPS LT 1975
105	02	05	ALL CROPS LT 1975
106	11	03	ALL CROPS LT 1975
107		5	CORN LT 1975 ACTU
108			CORN LT 1975 ACTU
109			CORN LT 1975 ACTU
110	10		CORN LT 1975 ACTU
111	25		CORN LT 1975 ACTU
112	15		CORN LT 1975 ACTU
113	10		CORN LT 1975 ACTU
114	05		CORN LT 1975 ACTU
115	20		CORN LT 1975 ACTU
116	20	08	CORN LT 1975 ACTU
117	49	13	CORN LT 1975 ACTU
118	25	00	CORN LT 1975 ACTU
119	23	28	CORN LT 1975 ACTU
120	10	00	CORN LT 1975 ACTU
121	55	20	CORN LT 1975 ACTU
122	105	25	CORN LT 1975 ACTU
123	95	43	CORN LT 1975 ACTU
124	60	18	CORN LT 1975 ACTU
125	108	15	CORN LT 1975 ACTU
126	190	50	CORN LT 1975 ACTU
127	17	07	CORN LT 1975 ACTU
128	03	03	CORN LT 1975 ACTU
129	50	18	CORN LT 1975 ACTU
130	05	28	CORN LT 1975 ACTU
131	20	03	CORN LT 1975 ACTU
132			CORN LT 1975 ACTU
133	03	05	CORN LT 1975 ACTU
134	03		CORN LT 1975 ACTU
135	03	05	CORN LT 1975 ACTU
136	05		CORN LT 1975 ACTU
137	05	03	CORN LT 1975 ACTU
138	23	20	CORN LT 1975 ACTU
139	28	33	CORN LT 1975 ACTU
140	33	10	CORN LT 1975 ACTU
141	30	20	CORN LT 1975 ACTU
142	38	28	CORN LT 1975 ACTU
143	110	78	CORN LT 1975 ACTU
144	65	23	CORN LT 1975 ACTU
145	65	15	CORN LT 1975 ACTU
146	30	35	CORN LT 1975 ACTU

1	59	75	56	54	53	52	51	48	48	53	58	60	62	66	65	67	72	74	73	71	66	64	61
1	60	75	55	54	54	57	58	61	62	63	65	68	72	74	76	79	78	80	79	74	67	63	63
1	61	75	59	56	56	54	52	51	47	52	57	61	65	67	69	71	73	73	71	68	63	61	59
1	62	75	58	57	56	56	55	55	54	54	54	54	54	57	57	59	59	58	57	54	50	49	46
1	63	75	40	40	40	40	40	40	40	40	40	41	43	43	45	46	46	47	47	46	42	43	43
1	64	75	41	41	40	40	40	41	41	42	43	43	43	44	49	51	54	54	55	54	53	53	53
1	65	75	53	54	54	54	55	57	58	59	62	65	67	69	70	77	77	78	77	75	72	70	68
1	66	75	69	69	69	69	67	67	67	68	72	75	78	77	80	74	72	70	67	63	59	56	54
1	67	75	47	46	45	43	42	41	41	45	49	53	56	59	61	63	63	64	64	61	57	57	56
1	68	75	55	55	53	[illegible]	50	50	50	50	52	53	53	56	56	58	62	65	71	71	70	69	68
1	69	75	64	62	62	62	62	54	50	51	53	58	60	63	63	64	63	61	60	58	57	57	56
1	70	75	53	54	55	55	55	57	58	56	59	61	61	57	65	67	77	78	76	74	72	71	70
1	71	75	72	72	72	71	71	70	70	70	70	73	78	81	77	71	66	61	58	55	54	52	52
1	72	75	42	41	42	40	39	39	39	38	38	38	40	42	44	47	44	46	44	44	40	39	37
1	73	75	32	30	29	30	31	30	30	35	40	43	48	51	52	55	57	58	59	57	53	51	50
1	74	75	45	47	46	44	44	45	46	48	50	54	57	60	61	61	60	61	60	60	57	57	58
1	75	75	60	60	58	57	56	55	55	57	59	63	64	64	66	67	66	64	63	61	59	56	55
1	76	75	51	51	51	50	49	50	50	52	55	60	61	64	65	61	59	58	58	58	57	58	58
1	77	75	55	55	53	54	57	57	54	58	62	66	59	70	72	72	72	71	70	67	63	58	57
1	78	75	47	45	44	43	42	42	43	53	59	64	69	75	77	78	79	78	77	73	67	63	61
1	79	75	53	54	54	53	50	49	49	56	62	71	72	74	77	79	79	78	77	75	70	68	67
1	80	75	61	63	63	62	62	62	63	63	65	67	70	70	72	74	76	76	74	73	71	70	70
1	81	75	69	69	69	69	69	69	69	70	72	74	75	78	81	82	81	81	78	77	75	73	72
1	82	75	70	70	70	71	72	72	70	70	71	71	73	73	74	75	75	75	75	72	72	67	65
1	83	75	56	54	52	51	50	50	50	56	61	64	65	68	70	73	73	71	70	67	63	59	54
1	84	S75	51	52	51	47	46	47	46	54	64	71	74	77	78	80	80	79	77	74	69	65	63
1	85	75	55	52	53	52	52	53	57	59	61	63	65	66	68	70	68	68	67	66	67	70	71
1	86	75	70	70	70	70	70	70	70	70	71	73	74	77	81	83	84	82	81	78	75	73	73
1	87	75	71	71	71	71	71	71	72	72	72	73	73	60	56	52	49	46	45	44	44	45	45
1	88	75	45	45	44	42	46	39	40	40	40	40	41	42	43	42	40	39	38	39	39	38	37
1	89	75	35	35	35	35	34	33	34	38	42	46	49	52	55	55	56	57	57	55	53	43	44
1	90	75	43	41	41	43	41	45	46	50	52	52	54	53	54	56	59	60	60	57	53	50	49
1	91	75	48	46	46	48	47	47	48	50	52	57	63	66	70	73	74	75	74	69	65	62	61
1	92	75	62	62	63	64	64	65	66	67	68	56	59	62	67	61	62	61	59	57	53	50	48
1	93	75	41	41	39	39	37	34	36	41	46	50	53	57	59	61	62	64	62	60	56	51	49
1	94	75	46	45	44	43	43	43	43	47	53	55	59	61	63	64	65	65	64	61	59	57	56
1	95	75	53	52	51	51	50	50	53	57	61	62	65	67	67	67	68	70	65	64	62	61	60
1	96	75	60	60	61	61	60	60	60	61	63	65	70	71	75	75	76	74	73	70	68	67	65
1	97	75	60	59	58	57	57	58	59	61	63	66	67	68	72	70	69	69	69	68	66	66	67
1	98	75	70	65	63	62	63	61	59	59	60	62	64	64	66	67	66	65	64	64	64	63	63

119	1	99	75	62	62	62	63	62	62	62	65	69	72	76	77	77	79	80	79	77	74	71	70	68
120	1	100	75	66	66	67	63	64	62	62	64	65	72	72	71	73	76	70	67	66	66	65	63	62
121	1	101	75	55	55	54	53	52	51	53	59	61	66	68	69	70	70	71	73	70	67	63	61	59
122	1	102	75	55	54	52	51	49	50	51	54	59	60	63	65	66	68	69	70	67	65	62	61	60
123	1	103	75	57	57	55	55	56	56	55	56	59	61	64	65	62	62	61	62	61	59	56	56	55
124	1	104	75	55	55	54	54	53	53	53	54	55	55	57	59	62	63	66	67	68	65	59	57	56
125	1	105	75	47	47	46	46	46	46	47	51	55	57	58	62	67	69	72	73	73	72	66	62	61
126	1	106	75	54	53	51	51	50	50	52	58	64	60	72	74	76	78	78	77	77	74	70	68	66
127	1	107	75	64	65	66	66	66	67	67	68	70	71	72	72	78	80	80	79	78	76	75	75	74
128	1	108	75	73	73	72	72	72	72	72	74	77	79	80	81	81	83	84	85	80	78	76	75	72
129	1	109	75	61	59	60	60	60	55	55	59	62	64	67	70	73	73	75	75	74	72	67	64	62
130	1	110	75	60	60	59	57	57	56	57	59	62	67	72	74	74	75	76	75	72	70	67	64	63
131	1	111	75	61	60	59	60	60	60	60	60	61	62	63	65	68	69	70	68	66	65	63	63	62
132	1	112	75	61	62	62	62	63	64	64	65	67	68	70	76	79	79	81	81	80	78	75	73	71
133	1	113	75	70	70	69	70	69	69	69	70	73	76	77	78	78	80	81	80	79	77	75	74	73
134	1	114	75	72	72	72	71	70	70	71	72	75	79	82	83	85	85	86	85	82	80	78	75	74
135	1	115	75	72	72	72	71	71	71	72	74	76	79	81	82	83	84	85	85	83	81	79	76	75
136	1	116	75	74	74	74	74	73	73	73	76	77	80	81	81	82	83	85	84	82	79	78	76	76
137	1	117	75	74	73	73	72	71	71	72	74	76	79	81	85	83	84	84	85	82	80	77	76	75
138	1	118	75	73	73	73	73	72	72	72	63	64	64	66	66	68	69	68	68	67	68	66	68	69
139	1	119	75	67	67	67	68	68	67	70	73	75	79	81	82	83	84	84	81	79	76	68	69	69
140	1	120	75	63	63	63	65	66	68	69	70	70	68	65	70	67	73	79	79	80	78	75	71	69
141	1	121	75	67	66	65	64	61	61	64	68	71	73	76	76	79	81	81	79	78	78	77	74	73
142	1	122	75	69	69	68	69	69	68	69	70	72	74	77	79	79	79	80	80	79	78	76	75	75
143	1	123	75	72	72	72	73	73	73	74	75	78	78	79	80	80	78	81	82	80	80	77	74	73
144	1	124	75	73	69	68	67	67	67	68	71	74	75	76	81	81	84	80	84	84	80	69	68	64
145	1	125	75	66	66	64	64	64	65	66	69	72	75	79	81	78	78	77	76	76	77	75	74	73
146	1	126	75	71	73	71	73	73	73	73	77	77	78	81	83	82	84	83	82	81	79	79	77	77
147	1	127	75	73	73	73	73	73	74	75	74	77	79	82	84	85	86	88	85	83	72	74	65	65
148	1	128	75	65	65	65	65	65	65	66	68	69	71	78	79	83	84	83	82	80	78	77	62	64
149	1	129	75	66	63	62	62	60	61	65	70	73	74	77	80	81	83	84	84	82	81	78	76	76
150	1	130	75	71	72	69	68	67	67	67	67	67	70	71	75	77	79	81	79	81	79	76	75	73
151	1	131	75	70	70	70	70	69	69	70	71	73	75	79	80	79	68	65	67	67	68	66	64	65
152	1	132	75	64	64	65	64	62	61	64	69	72	76	78	79	81	81	82	82	82	81	77	74	73
153	1	133	75	68	69	67	66	65	66	67	70	73	75	77	80	80	80	81	83	82	79	75	75	73
154	1	134	75	62	62	62	61	60	61	62	66	69	71	73	75	76	78	75	75	74	74	69	66	64
155	1	135	75	62	62	61	61	61	62	63	66	69	68	69	69	74	73	72	73	75	72	70	67	65
156	1	136	75	64	64	63	63	63	63	64	69	72	75	77	79	80	82	80	81	81	79	71	69	68
157	1	137	75	60	60	61	61	59	58	64	70	74	77	79	80	77	81	82	82	81	80	76	73	68
158	1	138	75	65	64	64	64	64	64	67	72	76	79	82	83	85	83	85	85	82	82	79	77	75
159	1	139	75	67	66	66	65	65	65	68	73	76	79	82	82	83	85	85	84	82	80	79	78	77
160	1	140	75	74	74	74	74	74	73	75	76	79	79	84	85	85	85	87	83	84	83	80	80	78
161	1	141	75	75	75	75	75	75	76	76	78	80	81	84	87	86	86	86	85	84	83	81	79	77
162	1	142	75	74	74	74	73	73	73	74	77	80	81	85	86	87	87	88	87	85	83	80	78	75
163	1	143	75	70	70	70	70	70	70	73	75	77	60	80	79	72	75	76	76	76	74	74	74	73
164	1	144	75	70	69	68	69	68	72	70	70	73	76	78	81	79	65	64	64	64	64	64	64	64
165	1	145	75	61	61	61	61	62	62	65	69	75	76	78	79	82	82	85	84	83	84	81	78	75
166	1	146	75	69	70	71	72	72	72	73	75	79	83	83	86	86	87	88	89	88	83	77	74	73
167	1	147	75	71	72	70	70	70	70	71	73	76	80	81	83	84	87	86	87	86	82	78	75	73
168	1	149	75	70	69	68	68	67	67	70	73	75	79	79	78	69	73	74	74	75	73	72	72	70
169	1	149	75	68	69	70	70	70	71	73	77	77	65	64	71	75	75	80	76	74	76	75	72	72
170	1	150	75	70	67	67	65	65	68	69	70	75	77	75	71	68	67	68	69	68	67	67	66	66
171	1	151	75	60	60	60	59	59	59	63	67	70	73	74	76	77	78	79	79	79	78	74	69	66
172	1	152	75	59	59	59	58	58	60	64	70	74	76	78	80	80	80	82	82	81	80	77	72	70
173	1	153	75	65	64	65	62	61	62	69	73	77	79	82	83	82	85	85	85	84	85	79	75	73
174	1	154	75	68	67	65	65	65	63	69	72	76	79	81	82	85	86	87	86	85	84	80	75	74
175	1	155	75	71	71	72	73	73	74	75	78	82	84	87	89	82	88	89	89	87	85	82	79	77
176	1	156	75	74	75	75	74	75	76	77	79	83	85	86	89	88	87	90	88	88	86	83	80	80
177	1	157	75	75	74	74	75	75	75	76	79	79	84	86	88	88	90	89	90	91	88	83	81	80
178	1	158	75	74	73	73	74	75	75	77	78	81	83	85	87	88	88	90	90	88	88	85	82	81
179	1	159	75	76	75	75	75	74	74	77	78	80	84	85	87	88	88	86	83	82	80	79	78	77
180	1	160	75	77	76	76	76	76	77	77	76	81	82	81	81	85	85	85	86	85	82	71	73	71
181	1	161	75	69	69	68	68	68	68	70	72	75	75	76	76	75	77	80	80	80	79	79	74	73
182	1	162	75	70	70	70	68	69	71	73	75	77	81	81	81	83	84	84	83	82	80	77	75	72
183	1	163	75	68	67	67	67	66	68	71	74	77	79	82	83	84	86	86	86	86	85	83	79	76
184	1	164	75	71	72	71	71	70	71	75	79	82	85	86	88	89	89	91	90	89	87	83	79	78
185	1	165	75	75	75	74	74	75	74	76	80	82	84	87	88	89	90	90	91	90	87	84	82	81
186	1	166	75	77	77	77	77	76	75	77	77	77	80	84	85	86	87	88	89	86	85	83	82	81
187	1	167	75	77	77	76	79	74	75	77	79	83	86	87	90	91	92	90	90	87	86	84	81	80
188	1	168	75	76	76	77	77	77	77	78	81	82	86	90	90	92	92	92	89	90	87	85	82	80
189	1	169	75	79	79	79	78	78	78	79	80	84	86	90	90	91	91	92	91	90	88	85	83	81
190	1	170	75	79	79	79	79	77	76	77	82	82	87	90	91	91	90	87	91	91	88	85	83	81
191	1	171	75	77	76	77	76	75	75	78	81	83	88	88	90	90	91	83	85	87	85	85	81	80
192	1	172	75	77	76	76	76	75	76	76	80	79	82	85	84	86	91	92	89	88	83	83	80	78
193	1	173	75	76	74	72	71	70	71	74	80	83	85	87	90	91	92	93	90	90	89	86	82	80
194	1	174	75	75	74	73	73	72	72	74	80	81	84	86	88	88	90	90	91	90	88	86	83	81
195	1	175	75	74	73	72	72	71	71	72	74	78	81	84	86	90	89	90	90	88	79	79	75	75
196	1	176	75	74	75	75	74	74	74	76	76	73	73	76	80	81	86	74	72	73	73	74	73	73
197	1	177	75	74	74	73	73	73	73	74	77	81	83	83	76	79	82	82	75	74	72	72	72	71
198	1	178	75	72	72	72	73	73	73	73	73	74	75	79	72	72	72	70	70	70	71	71	71	70
199	1	179	75	68	68	68	69	69	69	71	77	79	80	85	87	88	90	90	87	83	73	74	73	73
200	1	180	75	72	71	70	69	70	68	74	77	81	85	85	87	89	38	87	90	89	89	83	80	76
201	1	181	75	72	72	72	73	73	73	74	75	76	78	82	85	86	88	89	88	86	87	86	80	72
202	1	182	75	70	69	69	69	69	70	70	72	73	74	74	80	83	83	85	84	73	74	73	72	71
203	1	183	75	72	71	71	71	71	71	72	74	78	79	81	82	84	84	81	79	81	82	81	78	78

204	1	184	75	73	72	73	72	72	71	75	79	81	84	85	87	88	89	90	89	89	87	81	79	76
205	1	185	75	74	74	72	73	72	72	76	80	83	85	88	87	87	90	91	80	78	82	80	78	77
206	1	186	75	73	74	73	72	72	73	76	79	82	85	87	87	88	88	90	89	88	88	86	83	79
207	1	187	75	74	74	73	72	72	71	74	78	83	85	87	89	90	91	91	92	89	87	85	80	78
208	1	188	75	75	75	74	73	74	74	76	79	82	84	87	88	90	90	91	91	89	88	86	82	80
209	1	189	75	75	75	75	74	74	74	75	78	81	85	86	89	90	91	91	92	91	90	86	81	80
210	1	190	75	78	78	77	76	75	75	77	80	83	85	87	90	92	93	93	92	92	90	86	82	81
211	1	191	75	78	78	77	76	75	74	76	77	82	83	83	83	86	86	88	88	78	74	73	74	74
212	1	192	75	74	74	74	74	74	74	73	73	74	78	81	85	86	86	88	88	88	87	84	80	79
213	1	193	75	74	72	72	73	73	73	75	79	83	85	85	85	84	80	82	76	78	77	76	74	71
214	1	194	75	70	70	69	69	69	69	70	75	80	82	85	87	86	86	88	88	87	84	82	79	77
215	1	195	75	69	69	69	69	69	68	72	76	80	80	82	84	86	88	88	80	74	74	73	72	71
216	1	196	75	70	69	69	69	70	70	71	74	77	80	83	84	86	87	83	79	80	80	78	76	75
217	1	197	75	72	71	70	71	70	70	71	75	77	80	83	85	85	83	85	85	84	83	82	79	77
218	1	198	75	74	73	72	71	70	71	74	78	82	85	86	87	88	88	89	88	77	75	76	76	76
219	1	199	75	75	74	73	72	72	72	75	79	81	81	85	87	88	88	82	86	85	84	84	81	80
220	1	200	75	75	75	75	75	74	74	76	80	81	84	85	88	89	88	89	80	86	87	81	82	80
221	1	201	75	75	76	74	73	72	72	75	78	82	85	86	86	90	91	91	89	87	85	85	82	81
222		59	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

EXAMPLE OUTPUT

HOURLY TEMPERATURE INPUT FROM DAYS 59 TO 201
MAX/MIN TEMPERATURE INPUT FROM DAYS 202 TO 236

INPUT FOR THE MODEL HAS BEEN HELIOTHIS ZEA ONLY
INPUT READ FROM 82 TO 146
FACTD= 0.585 RUN NO.= 0ZEA EGGFRT= 0.900VIRS EGGFRT= 0.900
ZEA EGGS/MOTH = 300. VIRS EGGS/MOTH=******PLANTS/ACRE=14000.

CROP PHENOLOGY: IE= 71,IA= 80,IF=140,IM=155

DAY NO.	EGGPAR	1-3PAR	EGGPRD	1-3PRD	TCLOUD	NITMIN	TEMAVG	ADMOON	EGLYTM	SQUARES	BOLLS	EARS	HEADS	SAREA
82	0.003	0.000	0.007	0.010	0.0	58.8	70.5	0.730	68.0	0.	0.	0.	0.	1.2
83	0.004	0.001	0.011	0.015	0.0	51.7	59.5	0.610	58.7	0.	0.	0.	0.	1.2
84	0.006	0.001	0.015	0.020	0.0	57.0	63.1	0.450	65.7	0.	0.	0.	0.	1.3
85	0.007	0.001	0.019	0.025	0.0	70.1	63.2	0.240	69.3	0.	0.	0.	0.	1.3
86	0.009	0.001	0.022	0.030	0.0	71.8	74.2	0.240	73.7	0.	0.	0.	0.	1.4
87	0.010	0.002	0.026	0.035	0.0	44.2	58.7	0.530	44.7	0.	0.	0.	0.	1.5
88	0.012	0.002	0.030	0.040	0.0	35.7	40.3	0.750	38.0	0.	0.	0.	0.	1.5
89	0.013	0.002	0.034	0.045	0.0	43.8	44.8	0.890	46.7	0.	0.	0.	0.	1.5
90	0.015	0.002	0.037	0.050	0.0	48.3	50.2	0.960	50.7	0.	0.	0.	0.	1.5
91	0.016	0.003	0.041	0.055	0.0	62.2	59.1	1.000	62.7	0.	0.	0.	0.	1.5
92	0.018	0.003	0.045	0.060	0.0	42.7	58.6	1.000	50.3	0.	0.	0.	0.	1.6
93	0.019	0.003	0.049	0.065	0.0	46.7	48.9	1.000	52.0	0.	0.	0.	0.	1.6
94	0.021	0.003	0.052	0.070	0.0	53.5	54.1	1.000	57.3	0.	0.	0.	0.	1.6
95	0.022	0.004	0.056	0.075	0.0	60.4	59.8	1.000	61.0	0.	0.	0.	0.	1.6
96	0.024	0.004	0.060	0.080	0.0	61.2	65.9	1.000	66.7	0.	0.	0.	0.	1.7
97	0.025	0.004	0.064	0.085	0.0	65.3	64.6	1.000	66.3	0.	0.	0.	0.	1.8
98	0.027	0.004	0.067	0.090	0.0	62.4	63.3	1.000	63.3	0.	0.	0.	0.	1.8
99	0.028	0.005	0.071	0.095	0.0	66.0	69.3	1.000	69.7	0.	0.	0.	0.	1.9
100	0.030	0.005	0.075	0.100	0.0	57.2	65.7	1.000	63.3	0.	0.	0.	0.	2.0
101	0.031	0.005	0.077	0.103	0.0	55.2	61.2	1.000	61.0	0.	0.	0.	0.	2.0
102	0.032	0.005	0.079	0.106	0.0	57.4	59.2	1.000	61.0	0.	0.	0.	0.	2.0
103	0.033	0.005	0.081	0.109	0.0	54.7	58.1	1.000	55.7	0.	0.	0.	0.	2.1
104	0.033	0.006	0.084	0.111	0.0	50.2	57.2	0.990	57.3	0.	0.	0.	0.	2.1
105	0.034	0.006	0.086	0.114	0.0	56.0	58.2	0.990	63.0	0.	0.	0.	0.	2.1
106	0.035	0.006	0.088	0.117	0.0	65.9	64.4	0.980	68.0	0.	0.	0.	0.	2.2
107	0.036	0.006	0.090	0.120	0.0	73.1	72.0	0.970	74.7	0.	0.	0.	0.	2.3
108	0.037	0.006	0.092	0.123	0.0	65.0	75.5	0.940	74.3	0.	0.	0.	0.	2.4
109	0.038	0.006	0.094	0.126	0.0	60.7	64.7	0.910	64.3	0.	0.	0.	0.	2.4
110	0.039	0.006	0.096	0.129	0.0	61.7	65.1	0.860	64.7	0.	0.	0.	0.	2.5
111	0.039	0.007	0.099	0.131	0.0	62.1	62.8	0.820	62.0	0.	0.	0.	0.	2.6
112	0.040	0.007	0.101	0.134	0.0	70.7	70.5	0.730	71.7	0.	0.	0.	0.	2.6
113	0.041	0.007	0.103	0.137	0.0	71.9	73.8	0.610	73.0	0.	0.	0.	0.	2.7
114	0.042	0.007	0.105	0.140	0.0	72.9	76.6	0.450	74.0	0.	0.	0.	0.	2.8
115	0.043	0.007	0.107	0.143	0.0	74.5	76.9	0.240	75.0	0.	0.	0.	0.	3.0
116	0.044	0.007	0.109	0.146	0.0	74.2	77.5	0.240	76.0	0.	0.	0.	0.	3.1
117	0.045	0.007	0.111	0.149	0.0	73.9	77.1	0.530	75.3	0.	0.	0.	0.	3.2
118	0.045	0.008	0.114	0.151	0.0	67.4	68.5	0.750	68.3	0.	0.	0.	0.	3.2
119	0.046	0.008	0.116	0.154	0.0	65.5	72.9	0.890	67.3	0.	0.	0.	0.	3.3
120	0.047	0.008	0.118	0.157	0.0	66.9	69.8	0.960	69.3	0.	0.	0.	0.	3.4
121	0.048	0.008	0.120	0.160	0.0	70.8	71.9	1.000	73.3	0.	0.	0.	0.	3.5
122	0.049	0.008	0.122	0.163	0.0	73.3	73.9	1.000	74.7	0.	0.	0.	0.	3.6
123	0.050	0.008	0.124	0.166	0.0	70.8	75.8	1.000	72.7	0.	0.	0.	0.	3.7
124	0.051	0.008	0.126	0.169	0.0	65.1	72.5	1.000	65.0	0.	0.	0.	0.	3.8
125	0.051	0.009	0.129	0.171	0.0	72.9	72.2	1.000	73.3	0.	0.	0.	0.	3.9
126	0.052	0.009	0.131	0.174	0.0	74.8	77.2	1.000	76.7	0.	0.	0.	0.	4.0
127	0.053	0.009	0.133	0.177	0.0	65.7	75.3	1.000	65.0	0.	0.	0.	0.	4.1
128	0.054	0.009	0.135	0.180	0.0	64.7	71.4	1.000	64.0	0.	0.	0.	0.	4.2
129	0.055	0.009	0.137	0.183	0.0	71.8	73.2	1.000	75.0	0.	0.	0.	0.	4.3
130	0.056	0.009	0.139	0.186	0.0	71.4	72.7	1.000	73.3	0.	0.	0.	0.	4.4
131	0.057	0.009	0.141	0.189	0.0	63.9	69.5	1.000	64.3	0.	0.	0.	0.	4.5
132	0.057	0.010	0.144	0.191	0.0	69.5	72.5	1.000	72.7	0.	0.	0.	0.	4.5
133	0.058	0.010	0.146	0.194	0.0	66.4	73.2	0.990	73.3	0.	0.	0.	0.	4.6
134	0.059	0.010	0.148	0.197	0.0	62.7	67.5	0.990	64.0	0.	0.	0.	0.	4.7
135	0.060	0.010	0.150	0.200	0.0	64.1	66.7	0.980	65.0	0.	0.	0.	0.	4.8
136	0.060	0.010	0.150	0.200	0.0	63.2	70.8	0.970	67.3	0.	0.	0.	0.	4.9
137	0.060	0.010	0.150	0.200	0.0	67.0	71.0	0.940	70.0	0.	0.	0.	0.	4.9
138	0.060	0.010	0.150	0.200	0.0	69.8	74.6	0.910	75.0	0.	0.	0.	0.	5.0
139	0.060	0.010	0.150	0.200	0.0	75.0	75.4	0.860	77.0	0.	0.	0.	0.	5.1
140	0.060	0.010	0.150	0.200	0.0	76.2	78.8	0.820	78.0	0.	0.	102.	0.	5.3
141	0.060	0.010	0.150	0.200	0.0	75.2	79.5	0.730	77.3	0.	0.	359.	0.	5.4
142	0.060	0.010	0.150	0.200	0.0	72.6	78.8	0.610	75.3	0.	0.	865.	0.	5.5
143	0.060	0.010	0.150	0.200	0.0	71.1	73.7	0.450	73.0	0.	0.	1559.	0.	5.6
144	0.060	0.010	0.150	0.200	0.0	62.3	68.5	0.240	63.7	0.	0.	2296.	0.	5.7
145	0.060	0.010	0.150	0.200	0.0	72.7	73.2	0.240	75.0	0.	0.	3545.	0.	5.8
146	0.060	0.010	0.150	0.200	0.0	71.9	77.7	0.530	73.3	0.	0.	5375.	0.	5.9
147	0.060	0.010	0.150	0.200	0.0	71.1	76.8	0.750	73.7	0.	0.	7366.	0.	6.0

148	0.060	0.010	0.150	0.200	0.0	69.7	71.7	0.890	70.3	0.	0.	8967.	0.	6.0
149	0.060	0.010	0.150	0.200	0.0	69.6	72.2	0.960	72.3	0.	0.	10449.	0.	6.0
150	0.060	0.010	0.150	0.200	0.0	62.2	68.1	1.000	65.7	0.	0.	11489.	0.	6.0
151	0.060	0.010	0.150	0.200	0.0	62.5	68.6	1.000	66.3	0.	0.	12350.	0.	6.0
152	0.060	0.010	0.150	0.200	0.0	66.5	70.8	1.000	70.3	0.	0.	13051.	0.	6.0
153	0.060	0.010	0.150	0.200	0.0	69.1	74.3	1.000	72.7	0.	0.	13566.	0.	6.0
154	0.060	0.010	0.150	0.200	0.0	73.2	75.4	1.000	73.7	0.	0.	13859.	0.	6.0
155	0.060	0.010	0.150	0.200	0.0	76.1	79.7	1.000	77.3	0.	0.	14005.	0.	6.0
156	0.058	0.010	0.144	0.192	0.0	76.9	81.2	1.000	79.7	0.	0.	14005.	0.	6.0
157	0.055	0.009	0.138	0.184	0.0	76.4	81.2	1.000	79.7	0.	0.	14005.	0.	6.0
158	0.053	0.009	0.132	0.176	0.0	77.6	81.2	1.000	80.7	0.	0.	14005.	0.	6.0
159	0.050	0.008	0.126	0.168	0.0	76.8	79.6	1.000	77.3	0.	0.	14005.	0.	6.0
160	0.048	0.008	0.120	0.160	0.0	69.9	78.0	1.000	71.7	0.	0.	14005.	0.	6.0
161	0.046	0.008	0.114	0.152	0.0	71.5	73.5	1.000	73.0	0.	0.	14005.	0.	6.0
162	0.043	0.007	0.108	0.144	0.0	70.0	75.8	1.000	73.0	0.	0.	14005.	0.	6.0
163	0.041	0.007	0.102	0.136	0.0	74.1	76.9	0.990	77.3	0.	0.	14005.	0.	6.0
164	0.038	0.006	0.096	0.128	0.0	76.6	80.3	0.990	78.7	0.	0.	14005.	0.	6.0
165	0.036	0.006	0.090	0.120	0.0	78.6	81.9	0.980	81.0	0.	0.	14005.	0.	6.0
166	0.034	0.006	0.084	0.112	0.0	78.4	81.0	0.970	81.0	0.	0.	14005.	0.	6.0
167	0.031	0.005	0.078	0.104	0.0	78.2	82.2	0.940	79.7	0.	0.	14005.	0.	6.0
168	0.029	0.005	0.072	0.096	0.0	79.6	83.0	0.910	80.3	0.	0.	14005.	0.	6.0
169	0.026	0.004	0.066	0.088	0.0	79.7	83.7	0.860	81.3	0.	0.	14005.	0.	6.0
170	0.024	0.004	0.060	0.080	0.0	78.4	83.4	0.820	81.3	0.	0.	14005.	0.	6.0
171	0.022	0.004	0.054	0.072	0.0	78.2	82.0	0.730	80.3	0.	0.	14005.	0.	6.0
172	0.019	0.003	0.048	0.064	0.0	75.4	80.9	0.610	78.0	0.	0.	14005.	0.	6.0
173	0.017	0.003	0.042	0.056	0.0	76.7	81.6	0.450	80.3	0.	0.	14005.	0.	6.0
174	0.014	0.002	0.036	0.048	0.0	75.9	81.1	0.240	80.7	0.	0.	14005.	0.	6.0
175	0.012	0.002	0.030	0.040	0.0	74.9	78.6	0.240	75.0	0.	0.	14005.	0.	6.0
176	0.010	0.002	0.024	0.032	0.0	73.3	75.0	0.530	73.0	0.	0.	14005.	0.	6.0
177	0.007	0.001	0.018	0.024	0.0	71.9	75.2	0.750	71.3	0.	0.	14005.	0.	6.0
178	0.005	0.001	0.012	0.016	0.0	69.2	71.9	0.890	70.0	0.	0.	14005.	0.	6.0
179	0.002	0.000	0.006	0.008	0.0	71.5	76.6	0.960	73.0	0.	0.	14005.	0.	6.0
180	0.0	0.0	0.0	0.0	0.0	74.5	79.2	1.000	76.7	0.	0.	14005.	0.	6.0
181	0.0	0.0	0.0	0.0	0.0	72.2	78.3	1.000	74.3	0.	0.	14005.	0.	6.0
182	0.0	0.0	0.0	0.0	0.0	71.6	73.9	1.000	71.7	0.	0.	14005.	0.	6.0
183	0.0	0.0	0.0	0.0	0.0	74.4	76.8	1.000	77.3	0.	0.	14005.	0.	6.0
184	0.0	0.0	0.0	0.0	0.0	74.6	79.7	1.000	76.3	0.	0.	14005.	0.	6.0
185	0.0	0.0	0.0	0.0	0.0	74.7	79.3	1.000	76.7	0.	0.	14005.	0.	6.0
186	0.0	0.0	0.0	0.0	0.0	76.3	81.0	1.000	80.3	0.	0.	14005.	0.	6.0
187	0.0	0.0	0.0	0.0	0.0	76.6	81.1	1.000	78.7	0.	0.	14005.	0.	6.0
188	0.0	0.0	0.0	0.0	0.0	77.3	81.7	1.000	80.3	0.	0.	14005.	0.	6.0
189	0.0	0.0	0.0	0.0	0.0	78.5	82.0	1.000	80.0	0.	0.	14005.	0.	6.0
190	0.0	0.0	0.0	0.0	0.0	78.7	83.3	1.000	81.0	0.	0.	14005.	0.	6.0
191	0.0	0.0	0.0	0.0	0.0	73.9	78.5	1.000	74.0	0.	0.	14005.	0.	6.0
192	0.0	0.0	0.0	0.0	0.0	75.7	79.2	0.990	78.7	0.	0.	14005.	0.	6.0
193	0.0	0.0	0.0	0.0	0.0	70.7	76.6	0.990	72.0	0.	0.	14005.	0.	6.0
194	0.0	0.0	0.0	0.0	0.0	72.6	78.0	0.980	77.0	0.	0.	14005.	0.	6.0
195	0.0	0.0	0.0	0.0	0.0	70.2	75.1	0.970	71.0	0.	0.	14005.	0.	6.0
196	0.0	0.0	0.0	0.0	0.0	72.7	76.2	0.940	75.0	0.	0.	14005.	0.	6.0
197	0.0	0.0	0.0	0.0	0.0	74.5	77.6	0.910	77.3	0.	0.	14005.	0.	6.0
198	0.0	0.0	0.0	0.0	0.0	74.2	78.4	0.860	75.7	0.	0.	14005.	0.	6.0
199	0.0	0.0	0.0	0.0	0.0	76.9	79.7	0.820	79.7	0.	0.	14005.	0.	6.0
200	0.0	0.0	0.0	0.0	0.0	76.4	80.7	0.730	80.3	0.	0.	14005.	0.	6.0
201	0.0	0.0	0.0	0.0	0.0	77.6	81.2	0.610	80.7	0.	0.	14005.	0.	6.0
202	0.0	0.0	0.0	0.0	0.0	77.5	84.0	0.450	81.2	0.	0.	14005.	0.	6.0
203	0.0	0.0	0.0	0.0	0.0	77.5	84.0	0.240	81.2	0.	0.	14005.	0.	6.0
204	0.0	0.0	0.0	0.0	0.0	77.6	84.0	0.240	81.2	0.	0.	14005.	0.	6.0
205	0.0	0.0	0.0	0.0	0.0	76.9	84.3	0.530	81.0	0.	0.	14005.	0.	6.0

NATURAL MORTALITY

EGGS	1-3 LARVAE	4-5 LARVAE	PUPAE	ADULTS
0.045	0.040	0.040	0.030	0.150

BOLLWORM HELIOTHIS ZEA

DAYNO.	POSPAR	POSPRD	POS1-3	POS4-5	POSPUP	POSADT	PCSEGG	EGG	1-3	4-5	PUP	ADP	ADO	E-E	EGLYPR	FGLYCR	PRMGRT	SEXPTO
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	21	27	34	2	11	94	0.370	0.500	0.0	0.25
83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	23	27	34	3	13	100	0.132	0.510	0.0	0.26
84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	23	27	33	3	13	99	0.325	0.524	0.0	0.27
85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	23	27	33	3	13	99	0.433	0.536	0.0	0.29
86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12	22	27	32	2	10	95	0.554	0.556	0.0	0.31
87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	22	27	32	3	14	97	0.011	0.564	0.0	0.32
88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	22	26	32	6	18	99	0.011	0.564	0.0	0.32
89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12	21	25	31	5	17	94	0.011	0.565	0.0	0.32
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11	20	24	30	4	16	89	0.011	0.567	0.0	0.32
91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	19	24	29	3	14	85	0.267	0.573	0.0	0.33
92	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	19	23	28	3	14	83	0.011	0.580	0.0	0.34
93	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9	18	22	27	5	16	81	0.011	0.582	0.0	0.34
94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9	17	21	26	4	15	77	0.112	0.586	0.0	0.34
95	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8	17	20	26	3	13	74	0.225	0.592	0.0	0.35
96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9	16	20	25	3	12	73	0.403	0.600	0.0	0.36
97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	16	19	25	3	12	73	0.398	0.608	0.0	0.37
98	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	16	19	24	3	13	72	0.307	0.614	0.0	0.38
99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9	15	18	24	2	11	68	0.514	0.622	0.0	0.39
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9	15	18	24	3	12	69	0.314	0.629	0.0	0.40
101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8	14	17	23	3	13	65	0.240	0.633	0.0	0.40
102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8	14	16	22	3	14	63	0.241	0.636	0.0	0.40
103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8	13	16	22	3	14	62	0.067	0.638	0.0	0.41
104	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7	12	15	21	3	14	58	0.122	0.640	0.0	0.41
105	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6	11	14	20	3	14	54	0.310	0.643	0.0	0.41
106	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6	11	14	19	3	12	53	0.478	0.646	0.0	0.42
107	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6	10	13	19	2	10	50	0.649	0.651	0.0	0.42
108	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6	10	13	19	2	10	50	0.654	0.656	0.0	0.43
109	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6	10	13	19	3	12	51	0.362	0.658	0.0	0.43
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	10	13	18	3	12	49	0.375	0.659	0.0	0.43
111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	13	18	3	13	48	0.285	0.661	0.0	0.44
112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	17	2	11	44	0.615	0.662	0.0	0.44
113	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	17	2	10	44	0.661	0.663	0.0	0.44
114	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	17	2	9	44	0.661	0.663	0.0	0.44
115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	18	2	9	45	0.660	0.662	0.0	0.44
116	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	18	2	9	45	0.658	0.660	0.0	0.44
117	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	12	19	2	9	47	0.656	0.657	0.0	0.43
118	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	12	19	2	11	47	0.496	0.655	0.0	0.43
119	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	12	19	2	10	47	0.460	0.652	0.0	0.43
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	12	19	2	11	47	0.525	0.649	0.0	0.42
121	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	19	2	10	46	0.643	0.645	0.0	0.42
122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	19	2	10	46	0.638	0.640	0.0	0.41
123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	18	2	10	45	0.633	0.635	0.0	0.40
124	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	13	18	2	10	46	0.369	0.630	0.0	0.40
125	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	13	18	2	10	46	0.622	0.624	0.0	0.39
126	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	13	18	2	9	46	0.615	0.617	0.0	0.38
127	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	10	13	18	2	10	47	0.357	0.611	0.0	0.37
128	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	10	13	18	2	11	48	0.323	0.605	0.0	0.37
129	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	10	13	18	2	10	48	0.596	0.598	0.0	0.36
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	10	13	18	2	10	48	0.590	0.592	0.0	0.35
131	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	10	12	18	2	11	47	0.323	0.586	0.0	0.34

132	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	12	18	2	10	46	0.578	0.579	0.0	0.34
133	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	12	18	2	10	46	0.571	0.573	0.0	0.33
134	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	12	18	3	12	47	0.303	0.568	0.0	0.32
135	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	8	12	18	3	12	46	0.330	0.563	0.0	0.32
136	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	11	18	2	11	43	0.393	0.557	0.0	0.31
137	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	11	17	2	11	42	0.465	0.552	0.0	0.30
138	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	11	17	2	10	42	0.544	0.545	0.0	0.30
139	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	11	17	2	10	42	0.537	0.539	0.0	0.29
140	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	8	11	17	2	9	41	0.504	0.533	0.0	0.28
141	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	12	17	2	9	43	0.593	0.594	0.0	0.35
142	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	17	2	9	44	0.752	0.754	0.0	0.57
143	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	13	17	2	10	45	0.844	0.846	0.0	0.72
144	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	10	12	16	2	11	44	0.465	0.900	0.0	0.81
145	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	16	2	10	43	0.946	0.949	0.0	0.90
146	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	9	12	16	2	9	43	0.982	0.984	0.0	0.97
147	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	11	16	2	9	43	0.996	0.999	0.0	1.00
148	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	11	16	2	11	43	0.857	0.997	0.0	0.99
149	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	9	11	16	2	10	43	0.979	0.982	0.0	0.96
150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	8	11	15	3	11	42	0.594	0.958	0.0	0.92
151	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5	8	10	15	2	11	40	0.604	0.924	0.0	0.85
152	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	10	14	2	11	37	C.749	0.871	0.0	0.76
153	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	10	14	2	10	37	0.784	0.787	0.0	0.62
154	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	10	14	2	10	37	0.661	0.663	0.027	0.44
155	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	10	14	2	9	36	0.606	0.608	0.067	0.37
156	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	10	13	2	8	35	0.496	0.577	0.108	0.33
157	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	10	13	2	8	35	0.471	0.547	0.148	0.30
158	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	10	13	2	8	35	0.418	0.517	0.189	0.27
159	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	13	2	9	35	0.486	0.487	0.229	0.24
160	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	13	2	9	35	0.426	0.458	0.268	0.21
161	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	13	2	10	35	0.433	0.434	0.300	0.19
162	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	13	2	10	35	0.407	0.408	0.336	0.17
163	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	9	13	2	9	33	0.380	0.381	0.373	0.14
164	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	12	2	8	31	0.321	0.352	0.412	0.12
165	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	13	2	8	32	0.255	0.323	0.453	0.10
166	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	13	2	8	32	0.232	0.293	0.495	0.09
167	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	13	2	8	32	0.227	0.263	0.536	0.07
168	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	14	2	8	33	0.194	0.235	0.577	0.06
169	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	9	14	2	8	34	0.160	0.207	0.600	0.04
170	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	9	14	2	8	34	0.139	0.180	0.600	0.03
171	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	10	14	2	8	36	0.137	0.166	0.600	0.02
172	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	10	15	2	8	37	0.157	0.166	0.600	0.02
173	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	10	15	2	8	37	0.137	0.166	0.600	0.01
174	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	10	15	2	8	39	0.134	0.166	0.600	0.01
175	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	10	15	2	9	39	0.0	0.166	0.600	0.00
176	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	10	14	2	10	38	0.0	0.166	0.600	*******
177	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	10	14	2	10	38	0.0	0.166	0.600	1.06
178	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	8	10	14	2	10	38	0.0	0.166	0.600	0.00
179	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	10	14	2	9	37	0.0	0.166	0.600	-0.14
180	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	14	2	9	36	0.0	0.166	0.600	*******
181	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	14	2	9	36	0.0	0.166	0.600	-0.00
182	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	14	2	10	36	0.0	0.166	0.600	-0.00
183	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	14	2	9	36	0.0	0.166	0.600	-0.00
184	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	9	14	2	9	35	0.0	0.166	0.600	-0.00
185	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	9	14	2	9	34	0.0	0.166	0.600	-0.00
186	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	9	14	2	8	34	0.0	0.166	0.600	-0.00
187	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	9	14	2	8	34	0.0	0.166	0.600	*******
188	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	9	14	2	8	35	0.0	0.166	0.600	-0.00
189	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	10	14	2	8	36	0.0	0.166	0.600	-0.00
190	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	7	10	14	2	8	36	0.0	0.166	0.600	-0.00
191	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	10	14	2	9	37	0.0	0.166	0.600	*******
192	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	10	14	2	9	37	0.0	0.166	0.600	-0.00
193	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	10	13	2	9	36	0.0	0.166	0.600	*******
194	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	13	2	9	35	0.0	0.166	0.600	*******
195	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	13	2	10	35	0.0	0.166	0.600	-0.00
196	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	13	2	9	35	0.0	0.166	0.600	-0.00
197	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	7	9	13	2	9	35	0.0	0.166	0.600	0.00
198	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	9	12	2	9	32	0.0	0.166	0.600	0.00
199	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	12	2	9	31	0.0	0.166	0.600	-0.00
200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	12	2	8	31	0.0	0.166	0.600	-0.00
201	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	12	2	8	31	0.0	0.166	0.600	-0.00
202	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	12	2	8	31	0.0	0.166	0.600	*******
203	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	12	2	8	31	0.0	0.166	0.600	*******
204	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	12	2	8	31	0.0	0.166	0.600	*******
205	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	6	8	12	2	7	31	0.0	0.166	0.600	*******

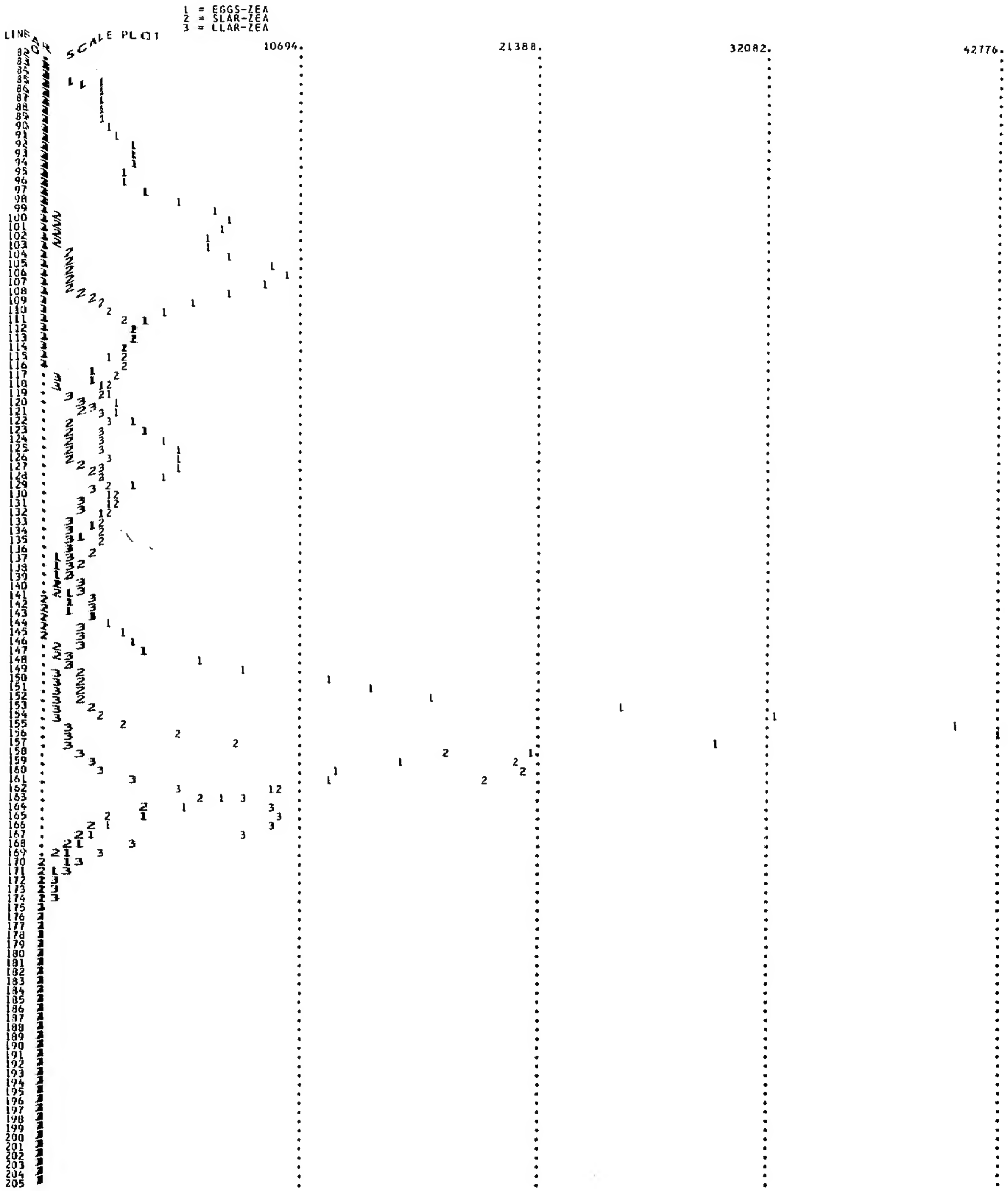
KK	I	SITES	PRBLAR	PRBNEW
82	0	16479.	0.0	0.0
83	0	17022.	0.0	0.0
84	0	17796.	0.0	0.0
85	0	18539.	0.0	0.0
86	0	19904.	0.0	0.0
87	0	20506.	0.0	0.0
88	0	20506.	0.0	0.0
89	0	20600.	0.0	0.0
90	0	20741.	0.0	0.0
91	0	21303.	0.0	0.0
92	0	21839.	0.0	0.0
93	0	22030.	0.0	0.0
94	111	22371.	0.0	0.0
95	113	22926.	0.0	0.0
96	113	23822.	0.0	0.0
82	114	16479.	0.0	0.0
83	115	17022.	0.0	0.0
85	114	18539.	0.0	0.0
86	115	19904.	0.0	0.0
88	117	20506.	0.0	0.0
89	118	20600.	0.0	0.0
91	118	21303.	0.0	0.0
93	118	22030.	0.0	0.0
95	118	22926.	0.0	0.0
96	118	23822.	0.0	0.0
98	117	25397.	0.0	0.0
99	118	26489.	0.0	0.0
100	121	27378.	0.0	0.001
101	121	28008.	0.0	0.001
103	122	28989.	0.000	0.001
104	121	29395.	0.001	0.003
105	122	29918.	0.002	0.005
106	123	30731.	0.004	0.007
107	124	31973.	0.CC6	0.006
108	125	33415.	0.008	0.006
109	126	34247.	0.009	0.010
110	127	35101.	0.011	0.025
111	128	35825.	0.019	0.015
112	129	36985.	0.022	0.018
113	129	38328.	0.0	0.021
114	131	39828.	0.029	0.014
115	132	41348.	0.029	0.003
116	133	42902.	0.024	0.004
117	134	44431.	0.020	0.009

118	135	45475.	0.019	0.006
118	137	45475.	0.019	0.002
119	138	46767.	0.014	0.002
120	139	47084.	0.011	0.001
121	140	49121.	0.009	0.001
122	142	50465.	0.007	0.002
124	140	53157.	0.005	0.003
125	142	54453.	0.005	0.003
126	144	55989.	0.005	0.005
128	144	58614.	0.006	0.006
129	144	59922.	0.007	0.001
130	145	61206.	0.006	0.007
131	146	62304.	0.007	0.006
132	146	63574.	0.008	0.007
133	147	64884.	0.009	0.007
134	148	65070.	0.010	0.005
134	150	65870.	0.010	0.004
135	152	66813.	0.009	0.002
135	146	66813.	0.0	0.001
137	154	69174.	0.006	0.001
141	152	360.	0.074	0.094
142	153	866.	0.043	0.022
143	154	1560.	0.027	0.020
144	155	2297.	0.017	0.012
146	156	5376.	0.010	0.0
147	154	7367.	0.0	0.007
148	157	8968.	0.004	0.028
149	158	10450.	0.006	0.035
150	159	11490.	0.009	0.040
151	160	12351.	0.012	0.053
152	161	13052.	0.017	0.018
153	162	13567.	0.014	0.027
154	163	13860.	0.014	0.065
155	164	13905.	0.024	0.092
156	165	13648.	0.039	0.107
157	166	13141.	0.065	0.208
158	164	12448.	0.0	0.292
160	167	10461.	0.247	0.565
161	168	8632.	0.373	0.469
162	168	6640.	0.297	0.419
163	170	5040.	0.284	0.339
164	170	3557.	0.286	0.292
165	171	2518.	0.306	0.252
166	172	1657.	0.310	0.258
167	173	955.	0.427	0.391
167	175	955.	0.476	0.204
168	176	441.	0.461	0.281
169	177	148.	0.464	0.422
170	178	1.	0.458	0.978
171	179	1.	0.344	0.0
172	180	1.	0.220	0.971
173	179	1.	0.0	0.974
174	182	1.	0.007	0.952
175	183	1.	0.0	0.913
176	182	1.	0.0	0.905
177	183	1.	0.0	0.887
178	183	1.	0.0	0.0
179	185	1.	0.0	0.808
180	186	1.	0.0	0.779
182	187	1.	0.0	0.0
183	188	1.	0.0	0.0
184	188	1.	0.0	0.0
184	190	1.	0.0	0.0
185	191	1.	0.0	0.0
186	191	1.	0.0	0.0
187	193	1.	0.0	0.0
188	194	1.	0.0	0.0
189	195	1.	0.0	0.0
190	196	1.	0.0	0.0
191	196	1.	0.0	0.0
192	196	1.	0.0	0.0
193	196	1.	0.0	0.0
195	196	1.	0.0	0.0
196	196	1.	0.0	0.0
197	196	1.	0.0	0.0
198	196	1.	0.0	0.0
199	196	1.	0.0	0.0
200	196	1.	0.0	0.0
201	196	1.	0.0	0.0
202	196	1.	0.0	0.0

PRINTOUT OF TOTAL POPULATICN OF VARIOUS LIFE STAGES ON ANY DAY
BOLLWORM HELIOTHIS ZEA

DAY NO.	EGGS	1ST-3RD	4TH-5TH	PUPAE	P ADULT	O ADULT	INPUT	EQELAC	MIGRATS	IN EGGS	PAR EGG	TOTMGS	TRICHS
82	0.	0.	0.	0.	0.	0.	11.	0.	0.	0.	0.	0.	0.0
83	760.	0.	0.	0.	0.	0.	8.	0.	0.	76.	0.	0.	0.0
84	1318.	0.	0.	0.	0.	0.	6.	0.	0.	131.	1.	0.	0.0
85	1696.	0.	0.	0.	0.	0.	2.	0.	0.	167.	1.	0.	0.0
86	1756.	0.	0.	0.	0.	0.	2.	0.	0.	172.	2.	0.	0.0
87	1758.	0.	0.	0.	0.	0.	1.	0.	0.	171.	3.	0.	0.0
88	1733.	0.	0.	0.	0.	0.	3.	0.	0.	166.	4.	0.	0.0
89	1922.	0.	0.	0.	0.	0.	6.	0.	0.	173.	5.	0.	0.0
90	2131.	0.	0.	0.	0.	0.	8.	0.	0.	202.	5.	0.	0.0
91	2583.	0.	0.	0.	0.	0.	9.	0.	0.	244.	6.	0.	0.0
92	3037.	0.	0.	0.	0.	0.	6.	0.	0.	286.	6.	0.	0.0
93	3246.	0.	0.	0.	0.	0.	3.	0.	0.	303.	7.	0.	0.0
94	3155.	7.	0.	0.	0.	0.	3.	0.	0.	294.	8.	0.	0.0
95	2909.	54.	0.	0.	0.	0.	4.	0.	0.	275.	10.	0.	0.0
96	2749.	171.	0.	0.	0.	0.	14.	0.	0.	258.	12.	0.	0.0
97	3407.	303.	0.	0.	0.	0.	22.	0.	0.	319.	11.	0.	0.0
98	4736.	420.	0.	0.	0.	0.	29.	0.	0.	435.	10.	0.	0.0
99	6454.	449.	0.	0.	0.	0.	20.	0.	0.	600.	9.	0.	0.0
100	7134.	524.	0.	0.	0.	0.	11.	0.	0.	663.	10.	0.	0.0
101	6959.	662.	0.	0.	0.	0.	2.	0.	0.	635.	12.	0.	0.0
102	6104.	794.	0.	0.	0.	0.	12.	0.	0.	535.	15.	0.	0.0
103	6268.	852.	0.	0.	0.	0.	23.	0.	0.	537.	15.	0.	0.0
104	7299.	844.	0.	0.	0.	0.	34.	0.	0.	631.	14.	0.	0.0
105	9197.	845.	0.	0.	0.	0.	25.	0.	0.	805.	13.	0.	0.0
106	9768.	840.	0.	0.	0.	0.	14.	0.	0.	869.	14.	0.	0.0
107	8780.	1023.	0.	0.	0.	0.	2.	0.	0.	816.	17.	0.	0.0
108	7135.	1671.	0.	0.	0.	0.	2.	0.	0.	622.	21.	0.	0.0
109	5636.	2019.	1.	0.	0.	0.	4.	0.	0.	476.	26.	0.	0.0
110	4241.	2334.	5.	0.	0.	0.	8.	0.	0.	372.	34.	0.	0.0
111	3428.	2841.	26.	0.	0.	0.	10.	0.	0.	294.	39.	0.	0.0
112	3215.	3220.	71.	0.	0.	0.	7.	0.	0.	251.	39.	0.	0.0
113	3255.	3282.	145.	0.	0.	0.	4.	0.	0.	219.	36.	0.	0.0

114	2776.	2988.	241.	0.	0.	0.	2.	0.	0.	190.	39.	0.	0.0
115	2057.	2832.	331.	0.	0.	0.	3.	0.	0.	159.	48.	0.	0.0
116	1677.	2878.	417.	0.	0.	0.	5.	0.	0.	114.	53.	0.	0.0
117	1639.	2472.	573.	0.	0.	0.	7.	0.	0.	102.	49.	0.	0.0
118	1835.	2137.	996.	0.	0.	0.	8.	0.	0.	120.	40.	0.	0.0
119	2062.	1687.	1231.	0.	0.	0.	8.	0.	0.	150.	34.	0.	0.0
120	2417.	1244.	1527.	0.	0.	0.	9.	0.	0.	175.	27.	0.	0.0
121	2630.	851.	1866.	0.	0.	0.	13.	0.	0.	214.	25.	0.	0.0
122	3059.	859.	2064.	2.	C.	0.	18.	0.	0.	257.	22.	0.	0.0
123	3641.	847.	2017.	10.	0.	0.	21.	0.	0.	325.	18.	0.	0.0
124	4121.	772.	1967.	38.	0.	0.	23.	0.	0.	394.	17.	0.	0.1
125	4734.	959.	2020.	85.	0.	0.	22.	0.	0.	442.	17.	0.	0.1
126	5007.	1162.	2023.	149.	0.	0.	19.	0.	0.	472.	18.	0.	0.1
127	4935.	1444.	1918.	206.	0.	0.	13.	0.	0.	453.	20.	0.	0.1
128	4204.	1765.	1726.	265.	0.	0.	8.	0.	0.	392.	24.	0.	0.1
129	3246.	2110.	1514.	419.	0.	0.	5.	0.	0.	296.	31.	0.	0.1
130	2347.	2370.	1225.	578.	0.	0.	4.	0.	0.	200.	40.	0.	0.1
131	2229.	2481.	1043.	796.	0.	0.	4.	0.	0.	139.	38.	0.	0.1
132	1784.	2129.	824.	953.	0.	0.	2.	0.	0.	129.	43.	0.	0.1
133	1424.	1992.	701.	1168.	0.	0.	2.	0.	0.	93.	47.	0.	0.1
134	1102.	1767.	770.	1310.	0.	0.	1.	0.	0.	65.	52.	0.	0.1
135	855.	1697.	909.	1324.	0.	0.	1.	0.	0.	46.	56.	0.	0.1
136	666.	1410.	834.	1292.	0.	0.	2.	0.	0.	35.	60.	0.	0.1
137	583.	1173.	908.	1303.	0.	0.	2.	0.	0.	30.	56.	0.	0.1
138	573.	869.	957.	1361.	0.	0.	3.	0.	0.	33.	47.	0.	0.1
139	620.	574.	1129.	1420.	0.	0.	4.	0.	0.	44.	36.	0.	0.1
140	714.	408.	1299.	1401.	0.	0.	4.	0.	0.	54.	30.	0.	0.1
141	786.	270.	1371.	1368.	5.	0.	6.	0.	0.	64.	26.	0.	0.1
142	851.	224.	1413.	1326.	18.	0.	9.	0.	0.	84.	25.	0.	0.1
143	1468.	310.	1370.	1290.	39.	0.	12.	0.	0.	122.	17.	0.	0.1
144	2289.	238.	1283.	1255.	64.	3.	12.	1.	0.	207.	14.	0.	0.1
145	2979.	273.	1180.	1255.	77.	11.	10.	6.	0.	272.	14.	0.	0.1
146	3230.	354.	1047.	1199.	83.	23.	7.	23.	0.	305.	16.	0.	0.1
147	3669.	550.	880.	1157.	132.	38.	0.	39.	0.	341.	17.	0.	0.1
148	5873.	754.	719.	1121.	183.	49.	0.	40.	0.	552.	15.	0.	0.1
149	8004.	1059.	550.	1113.	247.	60.	0.	49.	0.	730.	14.	0.	0.1
150	12060.	1267.	362.	1076.	255.	99.	0.	65.	0.	1046.	13.	0.	0.1
151	14041.	1022.	372.	1112.	291.	135.	0.	84.	0.	1242.	15.	0.	0.1
152	16619.	1110.	388.	1046.	257.	178.	0.	142.	0.	1495.	16.	0.	0.1
153	25134.	1480.	457.	1071.	246.	142.	0.	139.	0.	2289.	14.	0.	0.1
154	32082.	1907.	652.	1081.	110.	227.	0.	223.	6.	2893.	15.	6.	0.1
155	40457.	2741.	893.	1006.	91.	206.	0.	200.	20.	3772.	15.	20.	0.1
156	42776.	4887.	924.	1021.	100.	153.	0.	143.	34.	4038.	17.	34.	0.1
157	29469.	7724.	989.	1028.	72.	112.	0.	96.	43.	3554.	28.	43.	0.1
158	21085.	17325.	1256.	1062.	43.	83.	0.	67.	52.	2094.	37.	52.	0.1
159	13343.	20469.	1605.	1135.	25.	61.	0.	49.	60.	1275.	47.	60.	0.1
160	12376.	20671.	2016.	1232.	42.	38.	0.	30.	60.	891.	53.	60.	0.0
161	11798.	18887.	3279.	1415.	52.	24.	0.	17.	54.	601.	49.	54.	0.0
162	9373.	9575.	4943.	1406.	55.	13.	0.	11.	49.	580.	55.	49.	0.0
163	6851.	5851.	7778.	1426.	58.	12.	0.	10.	56.	386.	64.	56.	0.0
164	5233.	3641.	9256.	1575.	68.	9.	0.	8.	62.	239.	69.	62.	0.0
165	3399.	2293.	9724.	1889.	110.	7.	0.	7.	68.	170.	74.	68.	0.0
166	2281.	1663.	9225.	2444.	88.	6.	0.	6.	78.	83.	77.	78.	0.0
167	1506.	1030.	7770.	3307.	58.	5.	0.	5.	91.	59.	76.	91.	0.0
168	1063.	714.	3175.	4746.	40.	6.	0.	6.	145.	43.	72.	145.	0.0
169	970.	381.	1886.	9050.	31.	4.	0.	4.	153.	38.	72.	153.	0.0
170	692.	271.	1230.	10068.	22.	2.	0.	2.	138.	30.	71.	138.	0.0
171	449.	207.	809.	10421.	26.	2.	0.	1.	126.	20.	77.	126.	0.0
172	246.	189.	554.	10444.	44.	1.	0.	1.	113.	10.	77.	113.	0.0
173	109.	146.	567.	10222.	57.	1.	0.	1.	93.	6.	66.	93.	0.0
174	66.	130.	359.	9847.	82.	1.	0.	1.	88.	4.	65.	88.	0.0
175	41.	85.	179.	9364.	49.	2.	0.	2.	111.	2.	70.	111.	0.0
176	29.	47.	97.	9245.	140.	2.	0.	2.	149.	1.	64.	149.	0.0
177	16.	23.	29.	8726.	45.	3.	0.	3.	207.	1.	70.	207.	0.0
178	7.	18.	0.	8044.	124.	2.	0.	1.	181.	0.	83.	181.	0.0
179	3.	13.	0.	7133.	198.	5.	0.	5.	329.	0.	73.	329.	0.0
180	3.	7.	0.	6919.	304.	2.	0.	2.	253.	0.	72.	253.	0.0
181	1.	4.	0.	5638.	99.	5.	0.	5.	343.	0.	37.	343.	0.0
182	0.	3.	0.	2451.	392.	8.	0.	4.	392.	0.	0.	382.	0.0
183	0.	0.	0.	1471.	1150.	11.	0.	11.	713.	0.	0.	718.	0.0
184	0.	0.	0.	914.	698.	4.	0.	4.	553.	0.	0.	553.	0.0
185	0.	0.	0.	886.	395.	15.	0.	15.	920.	0.	0.	920.	0.0
186	0.	0.	0.	559.	94.	42.	0.	42.	2123.	0.	0.	2123.	0.0
187	0.	0.	0.	361.	122.	24.	0.	24.	2034.	0.	0.	2034.	0.0
188	0.	0.	0.	350.	96.	14.	0.	13.	1654.	0.	0.	1654.	0.0
189	0.	0.	0.	113.	32.	4.	0.	4.	1113.	0.	0.	1113.	0.0
190	0.	0.	0.	55.	84.	5.	0.	5.	832.	0.	0.	832.	0.0
191	0.	0.	0.	19.	45.	4.	0.	4.	630.	0.	0.	630.	0.0
192	0.	0.	0.	0.	27.	1.	0.	1.	429.	0.	0.	429.	0.0
193	0.	0.	0.	0.	12.	3.	0.	3.	410.	0.	0.	410.	0.0
194	0.	0.	0.	0.	3.	2.	0.	2.	317.	0.	0.	317.	0.0
195	0.	0.	0.	0.	1.	1.	0.	1.	202.	0.	0.	202.	0.0
196	0.	0.	0.	0.	0.	1.	0.	1.	144.	0.	0.	144.	0.0
197	0.	0.	0.	0.	0.	0.	0.	0.	95.	0.	0.	95.	0.0
198	0.	0.	0.	0.	0.	0.	0.	0.	56.	0.	0.	56.	0.0
199	0.	0.	0.	0.	0.	0.	0.	0.	32.	0.	0.	32.	0.0
200	0.	0.	0.	0.	0.	0.	0.	0.	20.	0.	0.	20.	0.0
201	0.	0.	0.	0.	0.	0.	0.	0.	6.	0.	0.	6.	0.0
202	0.	0.	0.	0.	0.	0.	0.	0.	3.	0.	0.	3.	0.0
203	0.	0.	0.	0.	0.	0.	0.	0.	1.	0.	0.	1.	0.0
204	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.0
205	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.0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3 = LLAR-ZEA
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SCALE PLOT
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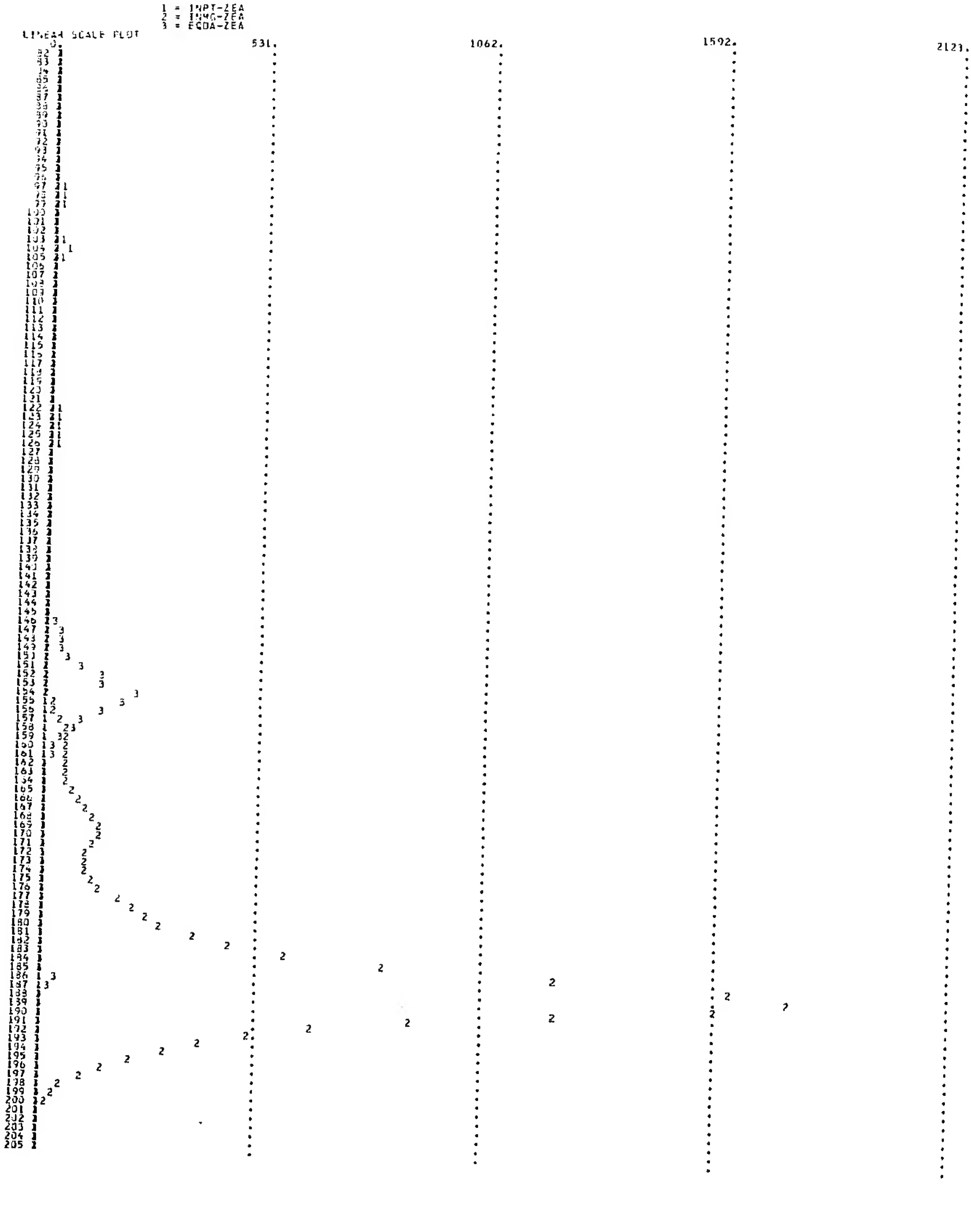

* 1976-G.P.O./1702-S/671-583/71

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